11: Sullivan D-4 (no date) 1922 OU9 Tonga OU9

A CONTRIBUTION TO TONGAN SOMATOLOGY

By LOUIS R. SULLIVAN

Based on the field studies of E. W. Gifford and W. C. McKern

INTRODUCTION

THE somatological studies in Tonga followed the plan previously used for Samoa.[1] The field records were made by E. W. Gifford and W. C. McKern, assisted by Delila S. Gifford and show evidence of unusual care and discrimination; the mathematical computations were prepared by my wife, Bessie P. Sullivan. By arrangement between the American Museum of Natural History and the Bishop Museum the analysis of the data and the preparation of the results for publication constitute my share of the work.

Mr. Gifford and Mr. McKern call attention to the assistance rendered by many individuals in Tonga and especially to the kindness shown by Their Majesties Queen Charlotte Tupou and Prince Consort William Tungi, who permitted themselves to be measured, thus graciously setting an example that was gladly followed by their loyal subjects. The Privy Council also greatly aided the expedition by instructing the Minister of Police, Mr. Job Koho, to provide the required number of persons for each day's examinations.

The material on which this paper is based consists of complete descriptions and measurements of 225 persons, 121 men and 104 women. Of these 10 were of mixed racial descent and their records were therefore discarded. Of the remaining 215, 184 were adults more than twenty years of age and 31 adolescents. The averages of non-quantitative descriptions are based on observations of young and old from the age of sixteen upward; the averages of all measurements except stature are based on measurements of persons of both sexes eighteen years old and upward.

By nativity the individuals examined are distributed as follows: Niuatoputapu 4; Niuafoou 1; Vavau group 25; Haapai group 40 (in detail, Haano 8, Nomuka 2, Uiha 4, Lifuka 6, other places 20); Tongatabu 148 (Nukualofa 47, other places 101); Eua 5; elsewhere 2. The material was not consciously selected and represents persons of all social classes and occupations. It may be regarded as a fair qualitative sample of the Tongan people.

[1] Sullivan, L. A., A contribution to Samoan somatology: B. P. Bishop Mus. Mem. vol. viii, No. 2, 1921. [113]

Let [p. 133]

13: Beaglehole & Beaglehole E-5 (1938-1939) 1941
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nuts were used for this purpose). On the remaining two days boiled food was eaten for the evening meal but an oven was made for the morning meal. Cooking food by oven, as already noted, is more laborious than the simple boiling. Large quantities of firewood must be collected, the oven heated, and time consumed in waiting for the food to be cooked. However, on these two days, it was possible to give variety to the diet by adding *kape, manioke,* and *papaia* to the oven-cooking.

The other three diet schedules follow the same trend as given in this example. There is a certain emphasis on one or other of the staples (*manioke, taro, kape,* plantain, green bananas) according to taste and relative amounts of each staple produced in the household-gardens. Breadfruit, yam, and sweet potato, are something of a luxury at this time of the year.

The amounts of food eaten were quantitatively measured by striking average weights for each staple, based upon actual weighing of tubers of *taro,* etc., and of plantains and bananas. The weights of these tubers vary somewhat during the year, depending on time of planting and harvesting. Thus, *kape* planted in March and harvested fourteen months later, weigh up to eighteen pounds.

One further variation in the diets is due to the amount of money (if any) that a household is prepared to spend on food, mainly meat and fish, and to the degree to which either the men or the women of the household are prepared to fish or explore the reef for edible relish. The head of Household A in Table 6 earned a small salary as a village school-teacher. In one week he was able to spend the sum of twelve shillings buying canned meat and fish. For this amount, he bought eight pounds of canned meat, six fresh fish and four small cans of fish. But he was practically the only person in the village who could spend at this rate and hence have protein as a steady diet for his household. A fisherman in Household B fished twice in this week, catching each time about twenty-five small fish, enough for two meals. The women in Household D concentrated on exploring the reef in such fashion that the household could enjoy reef-food for about

13: Beaglehole & Beaglehole E-5 (1938-1939) 1941
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tinned fish. It is apparently easier for the villager to buy a tin of beef from the store than to fish, even though the beef is the bull's toughest cut. But to buy the beef, you need money, and money you get by cutting copra to sell to the local store. Thus, the villager has tended to concentrate on his plantation and on his copra. From this point of view, the art of fishing is being so rapidly lost that the sea is becoming about as interesting and as important to the villager as it is to the average large city-dweller in our own society.

The villager does not bewail the loss of his techniques. He would become a mere sentimental antiquarian if he did, especially where new methods and novel appliances are more efficient than the clumsy and inefficient techniques of a past age. Where he might well feel, however, that the balance-sheet shows him in the red is in the arts of fishing and cooking and in the loss of the arts of leisure—the arts of dancing, singing, and playing. Here Christianity has taught him that play is mere idleness, dancing is sinful, and singing respectable, provided only that the music and words are concerned with sacred topics. As a result, the villager plays cricket and football in brief seasonal spurts and nothing at other times. He sings loudly in church, rarely at any other time. He leaves dancing to untutored children who dance in no tradition except that of their own making. All in all, change in these arts of leisure has given the villager time to spare. But for the *kava* circle and its saving sociability, he would tend to kill his time and then wonder why happiness so often eluded his searching.

THE HOUSEHOLD

The Pangai household consists of that group of individuals living together which uses the same cook-house for the preparation of common meals. Generally this group uses but one sleep-house. A further sleep-house may be necessary however, if the numbers of the household are large. The relationships of the persons making up the individual households (as determined by a census taken of all the households in the village) consist of twenty-six different groupings of kin. Omitting for the moment the biological groupings of parents and children, there are represented ten types of patrilineal relationship of household members to

32: Staveley & Douglas D-4 (no date) 1959
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BLOOD GROUPS IN TONGANS, (POLYNESIA)[1]

By J. M. STAVELEY and R. DOUGLAS

125 RESULTS OF TESTING 200 Tongans for various blood groups and abnormal haemoglobins are the subject of this report. A blood group study of this population has been reported by Kooptzoff and Walsh.[2] These workers tested 102 subjects for the A_1A_2BO, MNS and Rh systems. We have extended the blood group systems tested to include P, Lewis, Kell, Duffy, Kidd, Diego, Wright, Vel, Sutter and the serum Gm groups. Saliva was also examined for secretion of ABH and Le^a substances, and a search was made for abnormal haemoglobins.

GEOGRAPHICAL FEATURES[3]

101 The kingdom of Tonga consists of about 200 islands in three major groups, Tongatapu in the south, Vava'u in the north, and the Ha'apai 133 group lying between these. The islands of Vava'u are generally high and mountainous, those of Ha'apai and Tongatapu low-lying and of coral 131 formation. The kingdom lies between 15° and 23° south and 173° and 177° west, and is free from malaria.

[361] Nuku'alofa, the capital, is on the main island of the southern group, Tongatapu, and lies 1,100 miles north-east of Auckland. The population 161 of the kingdom in 1959[4] is given as 58,351, of which 56,669 are Tongans, 162 and 1,682 part Tongans, Europeans and others.

173 According to tradition, the inhabitants of Tonga came from Samoa somewhere about 950 A.D.

COLLECTION OF SPECIMENS

125 With the approval of the Government of Tonga, Dr. Sione Tapa, 126 Chief Medical Officer, generously undertook the selection of the subjects and the collection of the specimens. In this work, Dr. Sateki Tupou, Assistant Medical Officer, played a big part. From each selected person, a clotted blood specimen and blood in Alsever's solution with added antibiotics was obtained by venepuncture. The saliva specimen was obtained after the mouth had been rinsed with water, and was heated in a boiling water bath for ten minutes.

[101] The samples from the 200 people concerned in the study were collected in batches of 50; one batch in May 1959, two during July 1959, and one in September 1959. This allowed the collection to take place just prior to the departure of a ship for New Zealand. It also allowed the testing of each batch to be completed during the week after arrival

[122] [1] This work was carried out under a grant from the Auckland Medical Research Foundation.

[2] Kooptzoff & Walsh, 1957.

[3] Pacific Islands Year Book, 1956:109.

[4] Pacific Islands Year Book, 1959:111.

32: Staveley & Douglas D-4 (no date) 1959
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in Auckland. This was the third week after the collection of the specimens from the subjects. The specimens were refrigerated at about 4° C. continuously from the time of collection.

The subjects selected by our colleagues have no known foreign ancestry. There were 98 males and 102 females, ranging in age from 14 to 43 years. Their distribution according to the island of their birth, is as follows:

Tongatapu	125
Vava'u	33
Ha'apai	26
Eua	8
Ninafo'ou	5
Mu'a	1
Niuatoputapu	2

Methods[5] and Results

The ABO System:

The red cells were tested with anti-A, anti-B and anti-H (Ulex Europeus). Those reacting with anti-A were titred against a group B serum showing a marked difference in titre between A_1 and A_2 cells. The serum from each individual was tested with A_1 and B cells independently.

TABLE I

No. tested	Phenotypes per cent				Genes per cent		
	O	A_1	B	A_1B	O	A_1	B
200	43	45.5	8.5	3[6]	65.37	28.42	6.21

No A_2 specimens were found.

The MNS System:

Tests were made with anti-M, anti-N, anti-S, anti-U, anti-M^g and anti-Vw. Specimens positive with anti-S were tested with anti-s.

TABLE IIa

No. tested	Phenotypes per cent			Genes per cent	
	M	MN	N	M	N
200	OBS. 29.5	59.5[7]	11.0	59.25	40.75
	EXP. 35.1	48.28	16.62		

TABLE IIb

No. tested	S Positive per cent	Genes per cent		Chromosomes per cent			
		S	s	MS	Ms	NS	Ns
200	3.5	2.50	97.50	2.31	56.94	0.19	40.56

All specimens were positive with anti-U and negative with both anti-M^g and anti-Vw.

[5] Testing methods used were those detailed by Staveley and Douglas, 1958.

[6] Expected $A_1B = 3.5$ per cent. $Chi^2 = 0.1082$. $P = 0.75$.

[7] $Chi^2 = 0.241$. $P. = 0.56$.

32: Staveley & Douglas D-4 (no date) 1959
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The P System:

Specimens were tested with anti-P_1 serum and P_2 samples were then tested with anti-P + P_1.

TABLE III

No. tested	Phenotypes per cent		Genes per cent	
	P_1+	P_1—	P_1	P_2
200	35.5	64.5	19.69	80.31

All specimens negative with anti-P_1 were positive with anti-P + P_1.

The Lewis and Secretor Systems:

Anti-Le^a and anti-Le^a + Le^b sera were used with the red cells. Saliva specimens were tested in titration for secretion of AB & H substances and for secretion of Le^a substance. Saliva from group O individuals was tested with anti-H, from group A & AB with anti-A, and from group B people with anti-B.

Twenty-three of the saliva specimens were not included as they were unsatisfactory, mostly due to an accident during the heating when water got into the jars. The Lewis types of the corresponding blood specimens have also been omitted from the results in Table IV.

TABLE IV

No. tested	Phenotypes per cent			Phenotypes per cent		Genes per cent	
	Le^{a+}	Le^{a-b+}	Le^{a-b-}	Se	se	Se	se
177	23.7	61.02	15.25	69.49	30.51	44.76	55.24

Note: Le^a substance was found in the saliva of those whose red cells were Le^{a+} or Le^{a-b+}. Half those of the type Le^{a-b-} were found to secrete AB or H.

The Rh System:

The sera used for testing in this system were:

- 4 anti-C sera (of which 2 were 'pure' anti-C)
- 1 anti-C^w serum
- 1 anti-c serum
- 2 anti-E sera
- 1 anti-D serum (saline agglutinating)
- 1 anti-D serum (incomplete—used with ficin treated cells)
- 1 anti-V serum
- 1 anti-e serum (with samples positive with anti-E)
- 1 anti-f serum for the confirmation of R_o and R_z)

32: Staveley & Douglas D-4 (no date) 1959
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TABLE V[a]

No. tested	Phenotypes per cent					
	CCDee	CcDEe	ccDEE	CcDeef	ccDEef	CcDEEF
200	OBS. 46.5	36.5	4.0	8.5	4.0	0.5
	EXP. 47.61	33.46	5.88	8.62	3.04	0.02

Chromosomes per cent			
CDe	cDE	cDe	CDE
69.00	24.25	6.25	0.50

No samples positive with anti-V were encountered.

The Duffy System:

An anti-Fy[a] serum was used with all specimens and those giving negative reactions were tested with anti-Fy[b] to recognise Fy[a-b−], but this type was not found.

TABLE VI

No. tested	Phenotypes per cent		Genes per cent	
	Fy[a+]	Fy[a-b+]	Fy[a]	Fy[b]
200	98.5	1.5	98.78	1.22

The Kell System:

All specimens were tested with anti-K, anti-k, anti-Kp[a] and anti-Kp[b].

TABLE VII[b]

No. tested	Phenotypes per cent		'Genes' per cent	
	KKp[b]k	Kp[b]k	K[b]	k[b]
200	0.5	99.5	0.025	99.75

All specimens were negative with anti-Kp[a].

The Kidd System:

Only anti-Jk[a] was available.

TABLE VIII

No. tested	Phenotypes per cent		Genes per cent	
	Jk[a+]	Jk[a−]	Jk[a]	Jk[b]
200	72.5	27.5	47.56	52.44

Tests in other Systems:

The specimens were tested with the other available antisera; results are shown in Table IX.

[a] Calculations following Mourant, 1954.
[b] Following the notation suggested by Chown and Lewis quoted by Allen, Lewis & Fudenberg 1958.

32: Staveley & Douglas D-4 (no date) 1959
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TABLE IX

Antiserum	Number Tested	No. of Positive Reactions
Anti-Di^a	200	0
Anti-Wr^a	200	0
Anti-Js^a	200	0
Anti-Vel*	86	86

* Used with group 0 specimens only.

The Gm Groups:

The method used was that described by Moullec et al.,[10] with the modification that tubes showing inhibition of the agglutination of the sensitised cells by the rheumatoid serum were centrifuged before the results were accepted as Gm^a positive.

202 white blood donors in Auckland were tested as a control series

TABLE X

	No. Tested	Phenotypes per cent Gm^{a+}	Gm^{a--}	Genes per cent Gm^a	Gm
Tongans	200	100	0	100	0
Blood Donors	200	58.00	42.00	35.19	64.81

Abnormal Haemoglobins:

In all the 200 specimens the search for abnormal haemoglobins was made with the following tests:

(1) Sickling Test (using the Sodium Metabisulphite method).
(2) Films stained for 18 hours with 1% cresyl blue in citrate-saline were examined for the so-called haemoglobin-H 'inclusion bodies'.[11]
(3) Films, stained with Leishman stain, were searched for erythroblastaemia and hypochromic macrocytic red cells.
(4) The alkali denaturation method described by Singer et al.[12]
(5) Paper electrophoresis with barbitone buffer at pH 8.6.

It was not expected that haemoglobin-H would be separated on paper electrophoresis as the haemoglobin solutions were prepared by freezing the washed red cells from the Alsever's solution. However, none of the films stained with cresyl bllue showed the inclusion bodies.

No haemoglobin other than A was found, and the Leishman films showed no red cell abnormalities.

SUMMARY AND ACKNOWLEDGEMENTS

Results of testing 200 Tongans for various blood group systems and for haemoglobin variants are reported. The systems investigated were A_1A_2BO, MNS, P, Lewis, Secretor, Rh, Duffy, Kidd, Kell, Diego, Vel, Wright, Sutter and Gm. No haemoglobin variants were found.

[10] Moullec, Kherumian, Sutton & Espagnon, 1956.
[11] A preparation showing these inclusion bodies was kindly sent to us by Dr. J. A. M. Ager, St. Thomas' Hospital, London.
[12] Singer Chernoff and Singer, 1951.

41: Beaglehole E-5 (1938-1939) 1939
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TONGAN COLOUR-VISION.

By Ernest Beaglehole,

Victoria University College, Wellington, N.Z.

114 170 The following material regarding the colour vision of the Polynesian Tongans was collected during the course of a recent field trip [101] to Tonga. The data were collected by Pearl Beaglehole and myself from Tongans living in the village of Pangai, Vava'u, which was our headquarters while in the field, and from other Tongans from the out-patients' department of the Government Hospital, Neiafu, and from the Government Gaol, Neiafu. I have to thank Dr. J. C. Lopdell, Assistant Medical Officer, and Mr. John Feiloakitau, Chief Magistrate, both of Neiafu, for official assistance which helped us in the collection of the material.

125 The test used for colour-blindness was the Ishihara test (7th ed.), generally regarded as a reliable test for colour defects. We examined 151 135 Tongans, 67 males and 68 females. Five males 143 proved to be red-green blind, a percentage of 7·46. No cases of female red-green blindness were detected. No cases of blue-yellow blindness nor of complete colour-blindness in either sex were discovered.

[p. 170-A]

41: Beaglehole E-5 (1938-1939) 1939
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000 percentages may not be strictly comparable because of different tests used. Rivers, for example, relied largely on the Holmgren wool-matching test, which with white males, according to Clements, has given a diagnosed incidence of colour-defect about half that given by the Ishihara test. Clements' work on American Indians, American Negroes and some of the work on white males that he summarizes were all done with the Ishihara test. Comparing these three 143 groups with Tongan males, it may be noticed that the percentage incidence of red-green blindness is: Whites, 8·03; Tongans, 7·46; American Negroes, 3·7; American Indians, 1·7. These figures, taken in conjunction with the weight of evidence derived from all available test results, definitely suggest a possible racial difference in the incidence in males of red-green colour-blindness.

Colour-blindness among white females has a definitely much smaller incidence than among males. A generally accepted figure is about 0·4 per cent. Failure to discover a case of Tongan female colour-blindness was therefore to be expected.

[151] Of the five Tongan males with defective colour-vision, two were completely green-blind (Ishihara terminology based on responses to Plates 22 to 25 inclusive). The proportion of green-blindness to red-blindness among Whites, Negroes, and American Indians as reported by Clements (*l.c.* 429) is also in the approximate ratio of three to one.

143 One peculiarity was noted in the response of Tongan subjects to certain plates in the Ishihara 151 test. According to Ishihara, Plates 18 to 21 • 125 inclusive can hardly be read by the majority of normal subjects. Ten Tongan males, however (14·92% of those tested), and 13 females (19·11% of females tested), though otherwise perfectly normal in their colour vision, showed not the slightest hesitation in reading the hidden numbers on these plates and were very puzzled when others, including ourselves, were unable to see [128] what was to them clear and evident. I am unable to tell whether this Tongan facility is due to peculiarity in colour vision or to defects in the test itself. The hidden numbers become visible if the plates are looked at through a blue glass. Possibly the normal vision of some Tongans is more sensitive than that of Europeans to small [128] differences in brightness. On the other hand,

151 it may be noted that Collins (*l.c.* 219–220) using
143 the fourth edition of the Ishihara test in which
125 Plates 10 and 11 appear to correspond to Plates
128 18 and 19 of the seventh edition, found that 4% of whites with normal colour-vision could read the hidden number in Plate 10 (18) and 27% could read the hidden number in Plate 11 (19). Collins regards the results for Plate 10 as distinctly curious and puzzling, but she believes that Plate 11 is proved to be an unsatisfactory test-plate. It may be noted that the 'deviant' normal Tongans all read all the four plates with equal ease.

822 In regard to general colour-discrimination,
[125] Tongan informants, male and female, were asked to name a series of colours in a colour chart. Specific colour names collected were: *hinehina*, cream or white; *tetea*, skin white; *felofelo*, yellow or gold; *enga* or *engeenga*, yellow; *kula*, red; *uliuli*, black. There is no specific colour-name for blue and possibly none for green either. The Tongans use many descriptive colour-names. To give a few examples: *lanu moana*, blue (*lanu*, colour, *moana*, sea); *lanu mata*, green; *pancfunefu*, brown (dim, obscure, indistinct); *momea*, tan or buff (drab); *kupesi*, dark brown (stencil for making bark cloth); *loufusi*, deep green (banana leaf). Degrees of saturation are expressed by such qualifying words as *mama*, light, and *fakapo'opouli*, dark.

151 In view of colour-test results, the lack of a
822 specific colour-term for blue need not necessarily imply a poor discrimination for this colour, nor does the relatively poor Tongan colour-vocabulary necessarily connote weak colour-discrimination.[4] All informants were at pains to indicate that they had no difficulty in distinguishing clearly each of the colours in the colour chart. Their difficulty, they said, was simply one of finding words to
822 indicate clearly discriminated colours. Doubt-
182 less, as C. S. Myers has suggested,[5] colour names are formed where they are needed; where they are needless, they will not be formed, however great the sensibility of a people to specific colours. The Tongans seem to have developed sufficient colour terms adequately to control their

[113] [4] For a summary of the philological evidence and the theory based thereon, see Klineberg, Otto: *Race Differences*, New York, 1935, 142–144, and Clements, *l.c.* 420–422.

[113] [5] Myers, C. S.: 'Some Observations on the Development of the Colour Sense,' *Brit. J. Psych.*, 2, 1908, 381.

[p. 171-B]

43: Maude K-4,5 (1962) 1970
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ing may be more than offset by increases in overall production because of the longer period of cropping. Shifting cultivation systems, in other words, are fairly flexible, and may be able to undergo a good deal of intensification without change in the technique of maintaining soil fertility. 241 134 182

A brief examination of possible areas of stress within the agricultural system, following the approach of Farmer, Lea and Street (Farmer, 1954; Lea, 1964; Street, 1969), suggests that the above argument might possibly apply to Tonga. Increased intensity of cropping will produce changes in the fallow vegetation, in soil fertility and erosion, and in crop yields, and the severity of these changes gives an indication of the extent to which changes in the bush fallow system are necessary. 241 134 182 121

Firstly, increased intensity of land use has resulted in some changes in the fallow vegetation. In the densely settled areas the secondary growth consists of grasses and other herbaceous plants, and shrubs such as lantana (*Lantana camara*), and guava (*Psidium guajava*). Only where the fallow period is about four or more years in length do trees such as *Hibiscus tiliaceus* and *Rhus simarubaefolia* (*Rhus taitensis*) become established. Farmers in Ha'apai complain that more work is now needed to control grasses and other weeds, many of them in fact introduced, and the metal push hoe, introduced into Tonga last century, is now essential for land preparation and weeding. 241 182 241 182 137 241 182 412

Soil erosion, another possible indication of stress, is not a serious problem, and in Ha'apai and Tongatapu, the most intensively cultivated groups, the likelihood of erosion is restricted by the porous soil, the underground drainage and the lack of relief. On the other hand, it is widely believed that soil fertility in the more densely settled areas, particularly in Ha'apai, has declined with the increasing intensity of land use. The majority of farmers questioned in areas of high population density felt that yields had declined and blamed the shortening of the fallow period, while some also cited the increased planting of coconuts as a factor. These beliefs are partially suprorted by the results of chemical analyses made of Tongatapu and Ha'apai soils. On the 241 134 182 [125]

[p. 62-B]

basis of parent materials, relief and climate, Ha'apai soils should be very similar to those of Tongatapu, but in fact appear to have much lower levels of available phosphorus and possibly slightly lower levels of available potassium.[1] Soil analysis by itself, however, is not particularly conclusive, and no yield measurements or fertilizer trials have been made which might provide further evidence on the question of differences in soil fertility. Any decline in fertility that may have occurred has obviously been only moderate. The soils of Ha'apai are by no means nearly exhausted, and satisfactory yields are still obtained. During fieldwork it proved impossible to find a plot which farmers considered so depleted in fertility that it would have to be left fallow for more than about three years before reasonable yields could again be obtained. There is also no evidence to suggest that people in the areas of high population density have a diet poorer in quantity or quality than elsewhere in Tonga.

While there has therefore been some deterioration in the fallow vegetation and probably some decline in soil fertility there are as yet no indications of serious stress in the agricultural system. Food production per head may have been maintained by the increase in the length of cropping in relation to fallow, and by the shift in crops, and it is significant that, despite their complaints of declining yields, hardly any of the farmers questioned in the areas of high population density seemed to feel any need for changes in the bush fallow technique. The argument that changes in methods of maintaining soil fertility may not be necessary under Tongan conditions therefore receives some support, but it is not yet possible to determine whether the absence of serious stress reflects the ability of the soil to bear frequent cropping, or is more a result of the limited length of time the soil has been intensively farmed.

There are, however, further possible explanations for the failure to adopt new techniques. The rate of

[1]The samples were of the top 10 to 12 inches of *kelefatu* soils in the two groups. Ten samples were collected in Ha'apai and 21 in Tongatapu. The mean level of available phosphorus was 43 p.p.m. for the Ha'apai samples and 1052 p.p.m. for the samples from Tongatapu. The difference between these means is significant at the 2 per cent level. The mean level of available potassium was 373 p.p.m. in Ha'apai and 529 p.p.m. in Tongatapu, but this difference is not statistically significant.

[p.63-A]

awkwardness in my joining men in their kava-drinking, despite their entirely proper invitations that I do so, for I was aware that their normal discussions were set aside while I was there. I therefore participated less than I might have in this area of activity. I also could not participate freely in the women's talk of matters relating to sex and reproduction, because of my status as an unmarried woman. On the other hand, the fact of my being a woman made it easy for me to adopt the practice of dropping by at people's homes and casually sitting around while members of the household went on with their activities, for this is something that Tongan women do all the time. My relative youth also made it reasonable and not too undignified for me to spend time playing with the children, which I found very comforting when I felt lonely, and to join in many of the activities of the young adults.

Besides observation and participation, much of my village data was gathered in the course of a detailed house-to-house survey that I began after I had been in Motulahi for three months. In the course of the survey I was able to collect extensive biographical data for almost every individual in the village, filling in many gaps in my information about the people and using the survey questions as a springboard for discussion of other matters.

46: Decktor Korn E-5 (1969-1970) 1978 OU9 Tonga OU9
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None of these informants were paid, nor were they directly rewarded with gifts. However, my main informants and others in Motulahi who were of greatest assistance were members of the kin-groups in which I participated as a quasi-member. I understood their assisting me to be part of a wider context of reciprocities, one aspect of the anga faka-Tonga that I had come to Motulahi to study. 124 [125]

I wish to thank the Government of Tonga under His Majesty King Tāufa'āhau Tupou IV for permitting me to conduct fieldwork. My fieldwork was supported by an International Fellowship from the American Association of University Women, and this support is gratefully acknowledged. I would also like to thank many people in Motulahi and others in Tonga for helping me in carrying out my research, and to express special thanks to certain individuals for their graciousness and kindness towards me. However, I shall only name those who are identifiable in some public capacity. Much as I would like to name others in acknowledgement of my regard for them, I feel it incumbent upon me to protect their privacy. While I have given a fictitious name to the village in which I was based and have disguised the title of the noble, it would be impossible to shield their identity any further without distorting data that I have judged it important to present. Instead, I have done what I can in reporting my findings 122 122 124

621 shortage of land.

423 The conclusion to be drawn from this is that contemporary practices in Motulahi in relation to the organization of access to land may be indicative of what will be seen elsewhere on Tongatapu as the shortage of land becomes more widespread. On the other hand, the Motulahi experience of peaceable adaptation to land shortage does not necessarily indicate what may eventually happen once there is acute land shortage throughout the country and nowhere to drain off the excess population.

The Demography of Motulahi

128 Before proceeding to examination of contemporary social organization in Motulahi, something should be said about the demographic characteristics of the population. Immediately, one confronts the fact of population movement and the difficulty of making a summary statement of who the 125 people of any village in Tonga are. My demographic survey of the village was part of a detailed house-to-house survey conducted intermitently, beginning early in January 1970 and continuing at intervals until about the middle of 125 May. By the end of that period, some of the people who 166 were enumerated earlier in the survey were no longer living in Motulahi or were still in the village but living in some other household, while others came to live in Motulahi only after I had already surveyed the household in which they

125 lived. Demographers commonly deal with these fluctuations
166 by arbitrarily fixing on a particular date and enumerating the population present at that date. This suits their purpose of enumeration, but it is an intolerably arbitrary solution to the problem of ethnographic description (Colson
121 1954, Carroll 1975). In considering how to deal with this,
621 I realized that population flux is not a difficulty that gets in the way of perceiving the demographic characteristics of the village but, instead, is a vital element of
[128] proper description of local organization in Tonga. This view is expanded and explored in the next chapter, in the
621 analysis of household composition. For the present purpose
125 of presenting a demographic profile of the village, I am taking the population of Motulahi to be the sum of the people who were enumerated in the course of the house-to-house survey. People not living in a household at the time it was surveyed are not included here; to include them would inflate the population total and distort the age-sex proportions, since young adults are more mobile residentially than other sectors of the population.

162 According to this enumeration, Motulahi had 1,192
621 inhabitants in the early part of 1970, of whom 617 were male and 575 were female (see Table 7). A percentage breakdown of village population according to ten-year age categories indicates that more than half the population

[TEXT CONTINUED ON PAGE 92]

123 'squatters' lived in a small house on the same land, and in some ways can be considered part of the household.

[121] My original plan was to do a broad study of the arts and aesthetic [125] taste in Tonga. I gave value tests based on sculpture, began to learn the language and some dances, and observed tapa making. But mainly I just participated in Tongan life.

[121] On my second trip I stayed nearly one year and lived alone in a small, thatched Tongan house. However, for many purposes I was again part of a household. This was a commoner family consisting of a married couple plus their own and 'adopted' children. I usually spent two days each week in Lapaha, Mu'a, the village traditionally reknowned for its dancing. In Lapaha the family I stayed with consisted of a woman of a chiefly family; her husband, a man from a matāpule (ceremonial attendant) family; the woman's step-father, who was a commoner; and two young girls who did most of the work. This third family was Catholic, while the first two were Mormon and Wesleyan, respectively.

121 Building on my knowledge of Tonga gathered during the first trip, I decided to concentrate on two of their important cultural categories--dance and tapa making--and to explore the relation between these and 192 the social order. It should be noted that the Tongans have no verbalized category that would correspond to the Western concept of the 122 'arts.' A few months after I arrived Queen Salote died, which placed 765 both dance and tapa making under tapu. This tapu officially lasted 766 six months, but in effect really lasted for a year. Although my 784 [535] [287]

67: Maude, K-5 (1961) 1973 OU9 Tonga OU9

attempts to relate the Tongan material to the general statements of Geertz (1963) and Boserup (1965) on the effect of population growth on man/land relationships.

Varying approaches and methods have been used in this research in an attempt to combine depth of understanding with breadth of coverage. Some aspects of the system of man/land relationships, for instance the uneven population distribution or the pattern of internal migration, can only be understood by analysis at both the national and local levels. Other aspects, such as the functioning of the land-tenure system or the effect of population density on agriculture, require studies of individual gardens, households and villages, and the comparison of areas experiencing differing conditions. Broadly, the material used can be divided into four main types:

(1) Material relating to the whole of Tonga. This includes the reports of the 1956 and 1966 Censuses, the records and maps of the Lands and Survey Department, and official statistics and departmental reports.

(2) Material from detailed surveys at the level of the household and village. This includes a general household questionnaire survey of four villages in Tongatapu, the main island of Tonga, more specialized surveys of land holding (one village in Ha'apai) and food cropping (two villages in Tongatapu and one in Ha'apai), and the results of three previous village studies of land tenure.

(3) Material from reconnaissance surveys, which involved interviews with key informants in a number of other villages throughout Tonga. The object was to determine the extent to which conditions in these villages were similar to, or differed from, conditions in the villages studied in greater detail.

(4) Historical material, obtained through interviews and archival research, and from previous studies in Tonga. Such material, although limited in amount, is valuable in providing a time-dimension to some of the variables involved in man/land relationships.

The bulk of the material is from the detailed surveys, which were made within the framework of the village community. No attempt was made to draw a general random sample of households over the whole of Tonga; instead a small number of villages was selected and either all or a sample of the households in each were studied. At the time field-work was undertaken no suitable frame existed for an overall random sample; but there were also methodological reasons for the choice of an approach through the village. In an unfamiliar

67: Maude K-5 (1961) 1973 OU9 Tonga OU9

culture it is easier to gain an awareness of the less obvious aspects of man/land relationships when all—or a large number of—households from the same village are studied than when individual, widely-scattered households are surveyed largely in isolation from the community of which they form a part. Furthermore, a geographer is frequently interested in comparisons between areas rather than in data aggregated over a wide area, and village communities, each with its own territory, form convenient units for comparison. Consequently, while an overall random sample survey might have produced results with a higher degree of statistical validity when generalized to the whole of Tonga, this would have been at the cost of a lower level of understanding of some of the complexities of man/land relationships.

The main problem in a village approach is the choice of villages. In general, the villages studied were selected in an attempt to determine the effect of one or more variables on other variables in the system of man/land relationships; they were not chosen simply to represent 'typical' Tongan conditions, and therefore the data obtained from them cannot be used to calculate average values for Tonga. In Tongatapu, the four villages surveyed by means of a general household questionnaire were chosen to cover the major variations in population density and land-tenure conditions in the island. The form used included questions on household composition, land, agricultural activities and household income. In Ha'apai the questions on sources of income were dropped, as a hurricane had largely destroyed cash cropping in the group shortly before the time of field research, and more specialized surveys of land holding and food cropping were carried out instead. No detailed surveys were conducted in Vava'u, partly because of the even greater destruction of cash cropping there, and partly because the emphasis in research was on areas of high population density, and in Vava'u population densities are mostly below the national average.

LAND RESOURCES

The three main island groups, Tongatapu, Ha'apai and Vava'u, are all of raised limestone formation. Tongatapu has a flat to gently undulating surface, with only a few small hills rising just above the tops of the coconut palms. The islands of Ha'apai are small, low and scattered, except for the outlying high volcanic peaks of Tofua and

121 knowledge of cultural principles can one expect to predict behavior patterns? If not, what is the relationship between cultural principles and behavior? To begin answering these questions, two bodies of data are used: (1) a conscious model constructed from cultural principles relevant to kinship reciprocity, and (2) a behavioral pattern constructed from observed events.

121 602 The Tongan conscious model of kinship reciprocity depicts a flow of goods based on the ranking of kinship categories. These data exist at the conscious level; they do not include inferences concerning the [128] subconscious of social actors. In the text of this paper I use the terms ideological model and conscious model to refer to the pattern or kinship reciprocity described by cultural principles. The term, model, as used here means a representation of a behavioral pattern.

The phenomenal level of kinship reciprocity is represented by a behavioral pattern constucted from a sample of exchange events occurring between kinsmen. The behavioral pattern does not constitute a model as it is built up from the data; i.e., it is not a model of kinship reciprocity; it <u>is</u> kinship reciprocity.

Sampling Units and Samples

121 125 Exchange events are the sampling units and are defined as all transfers of goods or services from one principal to another in which rights of ownership and/or usufruct are also transferred. Two samples [124] of exchange events were obtained from one village. A stratified random sample, sample A, was drawn by selecting twenty household heads

125 through a procedure of random draws; methodologically, each household
121 head was considered to be a single stratum. For each household head
124 selected, all exchange events in which he or she was a principal were recorded for a period of five days. With five days being recorded for each of twenty informants, a one hundred-day record of exchanges was obtained. All one hundred days were recorded in one two-week period with the days recorded for each informant determined by his availabi-
[656] lity. Sundays were excluded from the sample as the government outlaws
[529] most economic activities on the Sabbath. Sample A, then, was used to obtain information on all types of exchanges including purchasing, trading, and gift-giving. This sample was also used to gather data on household incomes, consumption patterns, and household inventories.

A second stratified, random sample, sample B, was drawn by utilizing all household heads in the village, each informant being a single stratum. The procedure in this instance was to visit each informant at approximately two-week intervals and record information on four exchange events, two in which the informant had been a recipient and two in which he had been the donor. All exchange events in this sample involve material items or money where money was transferred as a gift or loan. Sample, B, then, consists only of exchange events that are instances of reciprocity, and is used to analyze the patterns of reciprocity.

121 Samples A and B were both obtained in the village of Puke which
125 was the scene of most of the research for this study. Puke is described
[101] in Chapter II. The samples are representative of exchange events

121
125 involving residents of that village during the active research period.

A sample of adoption transactions was obtained in another village
121
124 by an exhaustive sample of households. In each household the house-
125 hold head or his spouse was asked about the adoptive status of each of their children. Then information pertaining to the adoptive status of the household head and his siblings was obtained along with the same information for his spouse. The sample of adoptions and sample B discussed above provide the data for the behavioral patterns presented in Chapter VI. These samples will be more fully described where they are relevant to description or analysis.

[123] The conscious model of kinship reciprocity consists of data collected using the informal technique of participant-observation. In this case the conscious model was elicited again and again under various circumstances and from many different informants. The conscious model as presented in Chapter VI is a standardized version of ideals generally recognizable by members of the Tongan community. I think it safe to say that the conscious model is shared and accepted throughout Tongan society.

Field Techniques and Circumstances

114
101 Active research in the village selected as the research location began in December, 1970, and ended in September, 1971: throughout this period I had almost daily contact with the residents of this village.
123 I used the technique of participant-observation to collect data on several topics including social structure, kinship, subsistence, adop-

123 tion and fosterage, and interpersonal relationships generally.

125 Early in the research period a census of the village was conducted to obtain demographic information including data on housing, landholding status, and dominant economic pursuits for each household in the village.

124 123 Information on exchange events was collected by using formal survey techniques, but I might indicate here that survey research would have been difficult without first establishing myself as a rather consistent and benign part of the village milieu.[1] A A Participant-observation also allowed me to observe much of the material I recorded through the surveys and thereby provided an informal check on reliability and validity of that information.[2] B A

124 I do not pretend that the data on exchange events are perfectly accurate or representative of all exchanges. For instance, I know that informants failed to mention many exchange events which involved small, and what they considered to be insignigicant, items such as coconuts, salt, water and a number of other items; this was particularly true early in the research period. In fact, one household head was removed from the sample because he consistently gave information on only the exchange of large, prestigious items. Two others had to be deleted because of their absence during the research period.

114 122 124 During research an assistant acted as interpreter when necessary and provided valuable assistance in arranging transportation, interviews, and in establishing rapport with informants. I had two assistants during two different periods and found both to be willing and

114 115

A A [For footnotes, see p. 122--Analysis]

114 capable helpers, who were themselves constantly available as informants.
115

My own lack of competence in the Tongan language was a limiting
122
[124] factor but I was able to conduct inquiry into certain area in Tongan,
[125] primarily kinship and exchange, and I could administer the survey questionnaires. Only two of the adults in the village had any degree
[124] of competence in English, and both were usually unavailable as interpreters or informants.

121 The village I chose in which to conduct the study was selected primarily because of its convenient location and relatively small size.[3] A
A Puke is a typical of Tongatapu villages as it includes many recent immigrants from relatively isolated areas of the Kingdom, and can be generally described as one of the less developed villages. However, these characteristics of the village were only known in retrospect and it was not chosen because of them.

A. [For footnote, see p. 122--Analyst]
A

CHAPTER IV

ADOPTION AND KINSHIP

128 In this chapter I will present and discuss adoption of children as
597 one kind of exchange event and in Chapter VI, I will compare the pattern of reciprocity existing in adoption transactions with the conscious model of kinship reciprocity. Also in this chapter, I want to examine the motivations and beliefs pertaining to adoption as they further illustrate and clarify Tongan kin relationships and family organizations.

597 Nearly all adult Tongans have had some experience with adoption, either as adopters, adoptees, or by having more distant adopted kinsmen. The Tongan government sanctions only a few of these adoptions. Few appli-
597 692 cations for adoption are made to the courts because the circumstances
[177] of Tongan adoption do not fit the European model of adoption applied in the courts. In 1970 eighteen applications for adoption were made in the courts, sixteen of these were granted, and two were refused (Roberts 1970: 3). Of the 125 cases of adoption recorded during research only one was a legally recognized adoption.

597 The village of Puke, being small, had only a few cases of adoption
101 so a larger village, Vaini, was used for this part of the study. Vaini is a village of about one hundred households located on Tongatapu (See
597 Map 2). A A All households in Vaini were sampled by using the household head
124 or the household head's wife as an informant. Each informant was asked
[125]

A A [See p. 25--Analyst]

463

TABLE 11

Primary Occupation of Village Household Heads*

Occupation	Frequency	Frequency in Percent
Cultivator	25	59.5
Fisherman	5	11.9
Wage Laborer	6	14.3
Overseas Laborer	2	4.8
Other	4	9.5
Total	42	100.0

(125) * Figures based on January 1971 census by author.

592 of a nuclear family and this is the preferred form of household composi-
[594] tion. Also pointed out earlier was the fact that the Tongan household is the basic unit of production and consumption. It is the physical and
[861] social environment within which Tongans learn behavior and establish
592 patterns of behavior. The pattern of exchange indicates that the rela-
593 tionships established within the household and the family of orientation
431 are maintained after the members of the household have dispersed and es-
437 tablished new households.

594 The emphasis on the nuclear family reflected by the patterns of
178 exchange may be a relatively recent alteration in Tongan life style, an
431 alteration that has resulted in a "lag" between the conscious model and
439 the new situation. For instance, the population of Puke as presently
602 constituted has resulted from recent migrations that tend to break up
[166] kin groupings larger than nuclear families. For the individual resident of Puke this results in a limited range of kinsmen available with whom to carry on reciprocity. This means, of course, that the physical distribution of kinsmen may preclude operation of the conscious model for certain individuals.

597 Comparing the adoption sample to the sample of goods, exchange also
858 produces information on the overriding solidarity of the nuclear family.
431 Children, of course, cannot be compared to goods in terms of value, but
439 they are resources that can be weighed according to their relative social
[594] importance. Children are by far much more important than goods, and this is reflected in different patterns of exchange.[1]

592 In the village of Vaini where the adoption sample was obtained,
602
125

[For footnote, see p. 123--Analyst]

597 602 125 there were a total of eighty-four adoptions, three of which were cases where non-kin had been principals in the adoption transactions. So 592 602 4 percent of adoption transactions involve non-kinsmen while the comparable percentage for the transfer of goods is 49 percent. As stated 431 437 above 50 percent of the exchanges in the sample involving material items 597 593 were between principals who were parent-child or sibling-sibling. The comparable percentage figure for the adoption sample is 89 percent. I 431 437 [858] interpret this to mean that because children are more important resources than are goods, they circulate within a much smaller, more closely related group.

602 The other characteristic of the behavior pattern is that transac- 431 437 tion in terms of kin categories seems to be balanced rather than either the higher ranking or lower ranking categories being favored. The only explanation for this is that "balance" is an overriding concern in individual strategies, not only as mentioned for relationships between non-kinsmen but also between kinsmen. This situation of "balance" is not [597] present in the adoption sample, but certain demographic factors characteristic of Tongan adoption results in a one-way flow of adoptees that still does not conform to the conscious model.

597 Tongans adopt children as young as possible and young adults will be the persons possessing young children. So in cross generation transfers of children, the principal in the youngest of the two generations will be the donating parent rather than the adopting parent. For instance, in the Fa'e-Tama dyad, fa'e would probably be at the end of her childbearing years or beyond her childbearing years. Tama would be a

78: Weiner N-4,5 (1969) 1972
OU9 Tonga OU9

VI.. Laboratory Results

125 A phytochemical survey for the presence of alkaloids was undertaken in both the field and laboratory. Alkaloids were singled out for detection because they are most frequently the active drug compounds of plants. New interest in the medical properties of alkaloids arose when reserpine was demonstrated to be responsible for the hypotensive action of *Rauvolfia serpentina* (28). The more commonly known alkaloids are morphine, quinine, ergotamine, nicotine, strychnine, physostigmine, caffeine, to name a few.

Although plant alkaloids have been isolated and studied for over 150 years, only about 2% of all recorded plant species have been tested for alkaloids, and even fewer of the isolated compounds have been carried to full elucidation of their structures. Schultes (25) estimates that at least 8000 new alkaloids remain to be discovered as a result of one survey of 20,000 species done by one American pharmaceutical company. A recent survey enumerates nearly 5000 alkaloids now known.[3]

125 Raffauf's spot-test technique was used in the field (22). This consisted of slicing through the leaf blade or petiole of a freshly collected sample and squeezing a bit of the plant juices onto Whatman No. 1 filter paper. After drying in the air, this spot was treated with a droplet of modified Dragendorff reagent. Field tests using Raffauf's technique in all 59 species gave negative results. It now seems probable that one or all components of my reagent were inactive. While in the field, I carried the components of the modified Dragendorff reagent in two brown glass bottles, one marked "A" and the other marked "B." Component "A" was a solution of 0.85 g of bismuth subnitrate in 10 ml of glacial acetic acid and 40 ml of distilled water mixed with a solution of 8 g of potassium iodide in 20 ml of distilled water. Component "B" consisted of a mixture of 100 ml of distilled water and 20 ml of glacial acetic acid. Before use one volume of solution "A" was diluted with 2.3 volumes of solution "B," as described by Raffauf.

[3] Schultes, R. E. Personal communication to author. October, 1970.

[p. 447-B]

78: Weiner N-4,5 (1969) 1972
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TABLE IV

125 SPECIES TESTED FOR ALKALOIDS (ALL NEGATIVE)

Binomial	Plant Part
Annona muricata	leaves
Cananga odorata	leaves
Casuarina equisetifolia	bark
Clerodendrum inerme	bark
Erythrina variegata	leaves
Euodia hortensis	leaves
Ficus obliqua	bark and leaves
Glochidion ramiflorum	bark
Hernandia moerenhoutiana	leaves
Jasminium simplicifolium	bark
Lantana camara var. *mista*	leaves
Syzygium corynocarpum	leaves
Syzygium malaccense	bark
Tarenna sambucina	bark
Thespesia populnea	leaves

Using both Mayer's and Ecolle's reagents, two separate tests for the presence of alkaloids were completed in the laboratory. The two reagents were chosen because of their variable sensitivities to different kinds of alkaloids.

All tests conducted in the laboratory for the presence of alkaloids in 15 crude drug samples were negative. The species tested are enumerated in Table IV.

VII. Discussion

757 Apparently the Tongan prefers to be treated for serious ailments by doctors in the government hospitals. Plant remedies are employed in emergencies or when "European" medical practices have failed to 757 effect a cure. Tongan folk-medicine is an art practiced mainly by the oldest people. 184 Although one or two practitioners encountered on Tongatapu were about 30 years of [759] age; the others were well over 60. Young people generally consider plant medicine a form of superstition and look upon its practice as not really effective, if not actually dan- 757 gerous. There is no systematic schooling for transmitting these plant remedies from one 868 generation to the next, and for this reason I believe that with the passing of one more generation little of this traditional knowledge will survive, except in occasional notebooks stored with other possessions of another age.

[p.448-A]

85: Raven-Hart G,R-3 (no date) 1955 OU9 Tonga OU9
Vava'u

The best examples of the " level " ending in Tongan music are to be found in the popular tunes, which, although in many cases deriving from Western originals, have been so adapted to the local taste that these originals cannot now be identified, or only doubtfully. As Caillot writes: " No European tune can pass the lips of a Tahitian, for example, without being at once so changed in nature, transformed to such an extent as to become unrecognizable except by a musician " ; and, it might be added, not always by him. When Thomson was in Tonga, such originals were chiefly " Wesleyan hymns, military-band marches and Mozart's ' Twelfth Mass ' " ; to-day they are hymns, film tunes and Handel's " Messiah."

One such popular tune is " Tui Lavoni " (the name of a ship). This, as played to me by one of the real musicians of the island, has the " Western " ending: F major, 4/4, x:x:x:AB | CB:AG:FA:CC | D:B:–:AB | CB:AG:FG:AB | A:G:–:AB | CB:AG:FA:CC | D:B:–:AB | CB:AF:GG:F*e* | F:–:–. On the other hand, as sung for me by small boys it has the " level " ending: AB | CA:FF:FA:CC | D:B:–:AB | CA:FF:FG:AB | A:G:–:AB | CA:FF:FA:CC | D:B:–:DD | CA:FF:GA:FF | F:F:–.

(10) Another popular tune which presents points of interest is " Tau mai ya " (" Would that I," a love song). Many versions of this were noted: two are given here. The first as it was first recorded: F major, 4/4, FG | A:–,G:BA:GF | F:F:x:*e*F | G:–,*d*:F*e*:*dd* | *d*:–:–:*e*F | A:–,G:BA:GF | F:–,G:BA:GF | F:–,G:BA:GF | F:F:x:*e*F | G:–,*d*:F*e*:*dd* | *d*:–:–. The second in a more repetitious, and apparently more popular form: *e*F | A:–,B:AG:FF | F:F:–,F:*e*F | G:–,B:AG:FF | F:–:–:*e*F | A:–,B:AG:FF | F:F:–,F:*e*F | G:–,B:AG:FF | F:–,B:AG:FF | F:–,B:AG:FF | F:F:x:*e*F | A:–,B:AG:FF | F:–:–. It seems probable that the second is a development of the first ; if so, a Western original for the first version has perhaps been identified, and it may amuse readers to attempt to detect this (somewhat unexpected) original before reading the postscript to this paper.

It will be noted that both versions show the " level " ending very markedly.

[(11) It should, however, be added that, in two variants collected in Samoa, far from any dislike of the " Western " ending appearing, this was actually substituted for a descending scale of the FEDC type, in one case at the end of a repeated phrase, in the other at the end of the tune itself. The former is Hughes' " Cwm Rhondda " (" Guide me "), where the second and fourth lines normally end in C | B:A:G:–, but Samoa prefers the ending CA | G:F:G:–, perhaps by infection from the end of the tune. The second is the 1775 Songbook " Hursley " (" Sun of my soul "), where the original ending is D:D:D | C:–:A | B:A:G | F:–:–) but Samoa prefers D:D:C | B:F:A | G:F:*e* | F:–:–. However, much more material would be necessary before stating that the usual " Trinesian " preference for the level ending is absent, or weak, in Samoa.]

(12) As an experiment to test aural memory, the simple folk-tune " There's a hole in my bucket " was sung some twelve times to a class of about 20 boys aged from eight to fourteen. After ten days no one had enough idea of the tune to attempt it ; it was again repeated some twelve times, but after another week only one boy earned the sixpence promised for a recognizable version, curiously condensing the tune into five notes instead of the original six, and levelling the ending: C major, 3/4,

85: Raven-Hart G,R-3 (no date) 1955 OU9 Tonga OU9
Vava'u

c(D) | (E):A:A | B:C:A | B:C:A | B:C:C(D) | (E):A:A | B:C:A | B:C:C | C:-. It should however be added that no words were given with the tune, and that a wordless tune is a mere ghost of a melody for most "Trinesians," so that the test was hardly a fair one. A similar test made in Fiji, with words extemporized, was far more successful, and is dealt with in the paper mentioned in the Bibliography.

(13) A considerable amount of music is being composed in Tonga to-day, showing strong Western influence. In Thomson's time, their songs were "boating-songs, odes to Nature or to flowers, or laments, but never love-songs." To-day the favoured subjects are patriotic ditties, love-songs, and songs to Nature, in that order.

When harmonized by the composer, as a rule the alto and tenor parts tend to follow the melody, rarely striking out any melodic line of their own: very frequently the alto is merely a succession of thirds below the melody, as in the example D, and, as Thomson wrote, "A procession of consecutive fifths seems to afford them peculiar delight." The bass is the important part, and is often given a series of duologues with the other three parts combined. These points were well illustrated in a recent choral composition set as a test-piece (far more suitably than foreign music) for the singing competition already mentioned.

The favouritism shown to the basses is justified by their excellence, both in quality and range; one bass complained to me that he could sing "only" two octaves really well, from middle C down; another happily produced *four* octaves, from A below the bass clef upwards, with a very smooth transition to a strikingly pure falsetto. Favouritism is also shown in the hymn-singing, many of the tunes being pitched somewhat high for the sake of the basses; there are, Heaven be praised, no organs or other instruments in Tongan churches, and the choirmaster has merely a pitch-pipe to guide him. It is most sincerely to be hoped that no false ideas of progress, no pseudo-sophistication, may bring in organs or bands to spoil what is undoubtedly the best part-singing in the Pacific.

Another "progress" threatened is the production of a tune-book in the numerical sol-fa notation, especially undesirable should it merely transcribe from the Western hymn books the "correct" tunes and harmonies; if so, it is to be hoped that Tongan musical obstinacy will be able to ignore these in favour of their own traditional variants.

Postscript.—The suspected original for the first tune to "Tau mai ya" is the plainsong "Tonus Peregrinus," used for Psalm 114 ("In exitu Israel") only, and adapted also as an Anglican chant for this psalm. But there is no Anglican church on Vava'u, nor is this plainsong used in the Roman Catholic church there—and at most it could be heard once a month only.

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Burrows, E. G.: *Native Music of the Tuamotus* (Bishop Museum Bulletin 109), Honolulu 1933; and "Songs of Uvea and Futuna," *op. cit.* 183, Honolulu 1945. Of exceptional value in that not only are primitive tunes given but also "hybrids" showing Western influence.

127 The land tenure system was studied using land registers and survey maps with the help of the staff of
121 the Land and Survey Department, Nuku'alofa. The aim was to gather precise data on the total number and area of the different types of land holdings, which could in turn be used as a sampling frame for statistical surveys.

127 Statistical data on the export of copra, bananas, and other produce were gathered from records available at the
121 Tonga Copra and Tonga Produce Boards. These data were
439 important to the study because a large percentage of the produce exported through these Boards originates from the small landholders' bush allotments.

125 A year-long study of Talamahu Market in the capital
443 city of Nuku'alofa was carried out. Talamahu Market is the only permanent market place in the Kingdom which serves
125 as an outlet for local produce. Throughout 1971 and the beginning of 1972, the market was visited at least once a week to determine the seasonality and types and quantities of produce that were available.

125 On Saturday, January 22, 1972 from 6:00 A.M. to
114 10:00 P.M., seven senior high school students helped make a complete inventory of the amount, origin, destination, and means of transportation of all available commodities for a single day.

127 Black-and-white aerial photography (at a scale of
128 1:20,000), flown in August 1968 for the British Directorate

127 of Overseas Surveys, was used in the construction of an
128 agricultural land use/vegetation map of Tongatapu and a transect across the island. The agricultural land use/vegetation map was constructed on a cellulose acetate overlay using a photomosaic (46 photos). Most boundaries were later field checked and verified or corrected as necessary.

125 The transect across the island was constructed using a single photo of a 2.04 mile(3.29 kilometer) strip between the windward south coast (the liku) and the northern lagoon (Tahi Kele). The transect was drawn on an acetate overlay and sectioned into 52 equal segments of approximately 69 yards (63.3 meters) each. The entire length of the transect was then paced, and at each 69 yard interval the crop types, plant species, agricultural practices, and
133 elevational changes were recorded. The transect illustrates
137 the heterogeneity of the Tongan agricultural landscape from the steep windward south coast, which is characterized by littoral forest and savanna, to the low-lying leeward north coast, which is characterized by swamp and mangrove forests.

125 Random ground reconnaissance surveys were made of both the bush allotments ('api 'uta) and the town allotments ('api kolo) to gather accurate statistical data on the nature of the agricultural system. The land tenure [423] [241] system in Tonga is ideally suited to a random sampling survey because all of these allotments have been surveyed

125 423 [241]

and the gardens of each individual farmer are generally confined to the area of single bush and town allotments.

The sampling survey of the bush allotments was based on the total of 5,652 allotments on the island in 1971, comprising about 45,214 acres (18,085 hectares). A map of these allotments (Figure 1)provided an excellent base from which a random sample of 101 allotments was selected (Figure 2) using a random numbers table. Each of the 101 'api 'uta was visited and an inventory of relevant agricultural phenomena was taken.

As a result of preliminary study, an inventory scheme was generated (see Appendix A)[A] which took into account 263 different types of agricultural phenomena, which were classified as to their number, area, condition, etc. depending upon the nature of the particular phenomenon.

125 126

The following procedures were used to survey the 101 sample bush allotments ('api uta): 1) accurate maps for each sample allotment were drawn using survey books at the Land and Survey Department; 2) using these maps in the field, the boundary markers were located; 3) using pacing techniques, the acreages for all major crops and the location of all other trees and plants were plotted; 4) acreages of fallow ground were mapped and categorized with respect to the stage of regrowth; 5) data on the occurrence of other agricultural phenomena and practices were recorded; 6) upon completion of work in the field

[A] [See Category 125, pp. 350-358--Analyst.]

[TEXT CONTINUED ON PAGE 131]

Figure 2. Outline map of Tongatapu showing the distribution, locations, and sample numbers of the 101 (106 before unrepresentative samples were eliminated) allotments surveyed as part of the survey of bush allotments.

125 each day, the survey data were analysed, and codified
126 answers for each of the 263 survey questions were entered
125 onto standardized sheets. The volume and details of the information required for each sample allotment precluded the selection of a larger sample size. Moreover, after sampling appriximately 80 of the 101 bush allotments, very few, if any new crops, agricultural practices, or other unexpected agricultural phenomena were encountered.

The survey of the town allotments ('api kolo) presented different problems. There were no reliable maps that could be used as a sampling basis for all 59 towns and villages on Tongatapu (Figure 3). Also, a random sample taken from the entire universe of town allotments on Tongatapu would have used transportation time needed for the survey.

To overcome these problems, a stratified sample was selected of six towns and villages representing a range of population sizes and geographical locations. There were Kolomotu'a, Kolofo'ou, and Ma'ufanga, which comprise the capital city, Nuku'alofa; Tatakamotonga, which is part of Mu'a in east-central Tongatapu; Fua'amotu in the southeast; 'Utulau in the southwest; Niutoua in the northeast; and, Fo'ui and Ha'avakatolo in the northwest.

From each of these settlements a random sample of town allotments was inventoried. At the beginning of the

88: Thaman K-5 (1967-1973) 1978 OU9 Tonga OU9
Tongatapu

102
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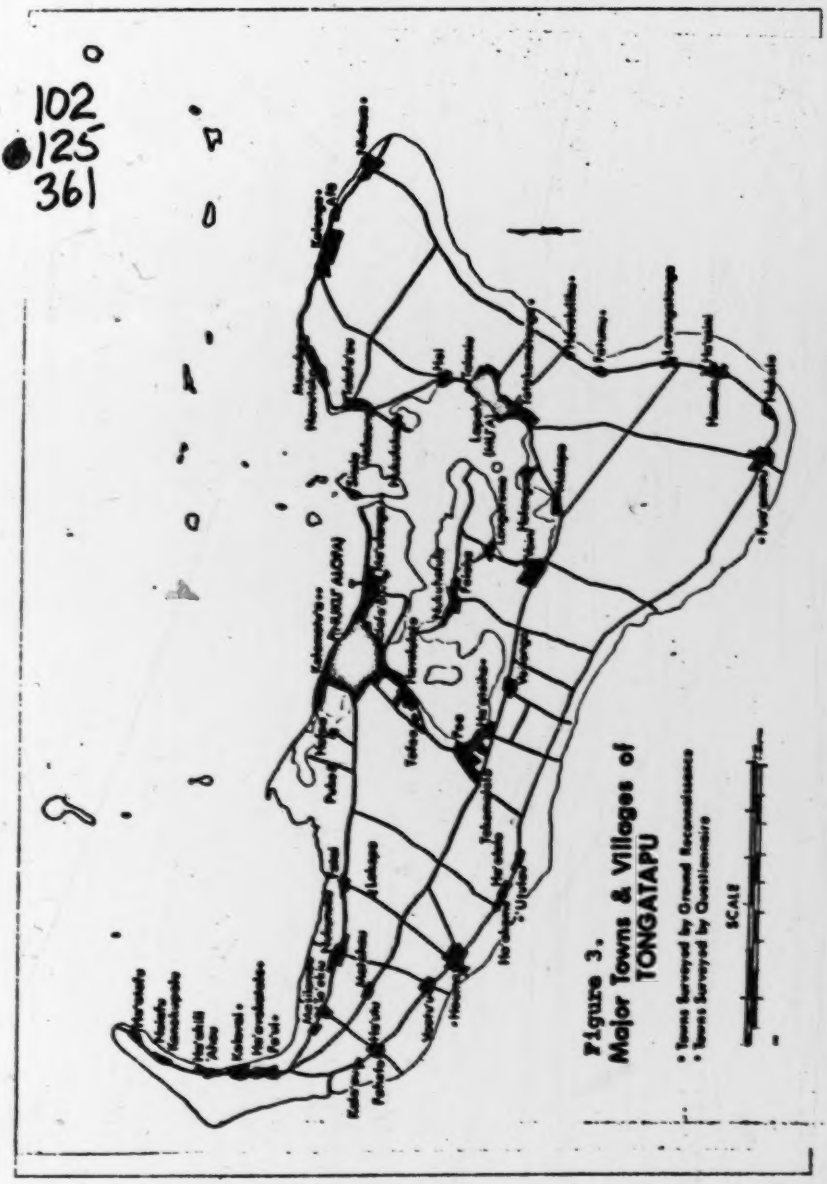

125 survey, one out of every ten occupied town allotments was sampled. However, this sample size was later reduced to one out of fifteen. The total number of town allotments sampled was 172. For each of these, an inventory of 241 different types of information on the nature of the door-yard gardens and other agricultural phenomena was carried [126] out. The data for each town allotment were recorded on standardized data sheets (Appendix B).[A]

In addition, a detailed questionnaire was used to gather data concerning Tongan views of the agricultural system (Appendix C).[B] The questionnaire was administered to 150 households in 9 settlements in four districts: Nuku'alofa, Vahe Hahake (Eastern District), Vahe Loto (Central District), and Vahe Hihifo (Western District) (Figure 4). A proportion of the sample was allotted to each district on the basis of estimated 1972 population. Within each district a stratified sample of villages was selected on the basis of size and geographical location: Kolomotu'a, Kolofo'ou, and Ma'ufanga in the Nuku'alofa District; Kolovai in the Hihifo District; Ha'ateiho and Houma in the Vaheloto District; and Haveluliku, Fatumu, and Kolonga in the Hahake District. (See Figure 3: "Major Towns and Villages of Tongatapu"). From complete lists of households for each village, individual households were [114] selected using a random numbers table (Table 1). A group of eight senior high school students were trained to help

[A][See Category 125, pp. 359-360--Analyst.]
[B][See Category 125, pp. 361-374--Analyst.]

[TEXT CONTINUED ON PAGE 17]

125 [114] administer the questionnaire.

Table 1. Number of questionnaires administered to representative village in each district.

District	Village	No. of Questionnaires
Nuku'alofa	Kolomotu'a	23
	Kolofo'ou	13
	Ma'ufanga	8
Hihifo	Kolovai	18
Vaheloto	Ha'ateiho	22
	Houma	21
Hahake	Haveluliku	7
	Fatumu	17
	Kolonga	21
TOTAL		150

126 [124] Throughout the year, plant specimens were collected from cultivated and natural vegetation. Folk names were obtained from Tongan informants, especially at the Talamahu Market where a consensus of opinion on the "correct" Tongan name could be reached. These identifications in Tongan were then cross-referenced in Yuncker's Plants of Tonga (1959) for tentative scientific names. Research was also carried out in the Agriculture Department's Herbarium, which contains specimens collected by H. Huërlimann (1951), T.G. Yuncker (1953), and E. Lawrence (1959). Fresh specimens collected in the field were compared with this collection to verify their identity. In addition, 193 herbarium specimens were collected and posted to California where

126 128

423 might be better tabulated on the basis of the household,
592 the major economic and social unit. In the survey of 150 households throughout Tongatapu, it was found that 89 percent had some access to bush allotments (Table 12).
423 Because the survey was administered to households that were
592 located on town allotments, all sample households had
128 either permanent or temporary access to a town allotment
[125] (Table 13). If the survey had been administered on a family or individual basis there would undoubtedly have been a number of people without rights to town allotments.

162
423 Table 11. Number of eligible males with and without bush allotments (Nuku'alofa figures include Haveluloto; Tongatapu figures do not include 'Atata and 'Euaiki).
[128]

	With	%	Without	%	Not Stated	%	Total
Nuku'alofa	1328	32	2757	67	23	1	4108
Tongatapu	4774	39	7479	61	69	1	12322
Other Islands	3531	46	4074	53	47	1	7652
Tonga	8305	42	11553	58	116	1	19974

Source: 1966 Census:89-96.

423 In those villages outside of Nuku'alofa, only four out
592 of 105 households had no access to tax allotments. In
369 Nuku'lofa (Kolomotu'a, Kolofo'ou and Ma'ufanga), however, 12 our of 45 had no access to bush allotments (Table 12).

Figure 12. Outline map of Tongatapu Island showing the location of the 2.04 mile(3.28 kilometers) sampling vegetation transect. The transect begins at point A in the coastal littoral forests of the upraised south coast and ends at point B in the mangrove forests along the low-lying north coast.

241 comparison with other portions of Tongatapu, however, this
311 area has a relatively uniform secondary regrowth dominated
137 by Panicum maximum (saafa) and other grasses and relatively
125 few important tree species. For Tongatapu as a whole,
128 because of the diversity of plant species and associations,
241 as well as their rapidly changing nature, it was decided to
311 conduct an exhaustive random sampling survey of the bush
137 allotments as described in Chapter I and Appendix A.
A 1 Consequently, the quantitative data presented are based on the survey of 101 or 1.8 percent of the approximately 5,652 bush allotments on Tongatapu. The sampled allotments had a combined area of 806 acres (326 hectares), 1.8 percent of the 45,214 acres (18,298 hectares) of bush allot-
128 ments on Tongatapu. From the total of 101 sample bush
241 allotments, 29 allotments were mapped to give the reader a
311 feeling for the diversity of agricultural landscapes
137 (Table 28 and Figures 14-42). In an effort to subjectively
[126 evaluate distributional patterns of vegetation types or
128 other related agricultural phenomena, the presence or absence of each item in the survey was plotted on maps of Tongatapu. An example of these maps is shown in Figure 43.

Extent of Cultivation

311 In the sample of 101 bush allotments, approximately
241 275 acres (111 hectares) or 34 percent of the total area was cultivated. This amounted to an average cultivated area of 2.7 acres (1.1 hectares) per allotment. However, of the

A [See Category 125, pp. 10-15, 350-358--Analyst.]

[TEXT CONTINUED ON PAGE 239]

241 crops, 4 percent in commercial crops, and 1 percent had both intercropped. Of the 87 allotments which were cultivated, all had subsistence crops, whereas only 31 allotments had commercial crops (Table 30).

241 311 Table 30: Frequency and area of specified types of cropping, pasture, and fallow on 101 sample bush allotments.

Cropping Type	No. of Allotments	Ave. Acreage (Hectares) per Allotment	Total Acreage (Hectares)	% of Total Acreage
Subsistence	87	2.4 (0.9)	233.9 (96.7)	30%
Commercial	31	0.3 (0.1)	29.0 (11.7)	4%
Sub/com.	10	0.1 (<0.1)	7.6 (3.1)	1%
Total. Cult.	87	2.7 (1.1)	275.5 (111.5)	34%
Pasture	1	<0.1 (<0.1)	3.1 (1.3)	0%
Fallow	101	5.2 (2.1)	527.7 (213.6)	65%
Total Sample	101	8.0 (3.2)	806.3 (326.3)	100%

241 ●125 Major Staple Crops

The frequency of occurrence and estimated acreages of major staple crops as dominants for the 101 sample allotments were obtained from inventories of all crops present and by pacing plots of staple crops (Table 31).

241 occasionally planted alone as dominants. Nevertheless,
244 Table 31 does give a good indication of the crops most
245 widely cultivated as dominants during 1971.

241 None of these staple crops seem to be concentrated in specific areas of Tongatapu.

Supplementary Food Crops

Throughout the matrix of dominant staple crops and bush-fallow vegetation are found a variety of supplementary food plants which play an important role in the diet. [125] Because most of these are intercropped with the staple crops or found in bush fallow vegetation, the survey tabulated their frequency and abundance rather than the area occupied. The papaya or lesi (Carica papaya) is the
241 most widespread supplementary food plant, occurring on 88
245 of the sample bush allotments (Table 32). It is generally found either intercropped with other subsistence crops or as a volunteer in bush fallow. Three allotments had rows of papayas in small plantations, 40 allotments had at least 10 trees, and 45 had 1 to 9 trees.

241 In the cases of si (Cordyline terminalis), chili pepper or polo fifisi (Capsicum frutescens), and the cherry tomato or temata vao (Lycopersicon esculentum var. cerasiforme), it may be debated as to whether or not these are indeed "cultivated plants," because they are so commonly found as volunteers. All three species are widespread on

241 Granadilla or pasiona (Passiflora quadrangularis) was
245 found on only 1 of the sample allotments along a trail through one-year bush fallow vegetation.

241 None of the supplementary crops seemed to be localized in particular regions of Tongatapu.

Important Non-Food Crops

Throughout the matrix of major staple crops and secondary vegetation, there are also a considerable number
[125] of important non-food crops (Table 34). The survey of these, like that of supplementary food plants, emphasized frequency and abundance with a secondary concern for the areas occupied by the few species which are planted alone in homogeneous plots.

241 The most widespread non-food plant which is cultivated
247 or at least protected on bush allotments is pandanus
[285] (Pandanus spp.). The leaves or lou'akau are used as fiber for weaving baskets, fine mats, and other plaited material. These species are more bush-like than the common screwpine or fā (Pandanus tectorius) and are found as borders, alone in homogeneous plots, amongst secondary vegetation as relics and volunteers, and in coastal and swamp forests on many allotments. Of the 76 sample allotments where pandanus was present, 32 had more than 25 plants, 21 had 10 to 25 plants, and 23 had less than 10. Of the 32 allotments with more than 25 plants, 4 had solid plantings of Pandanus averaging about .02 acres (.01 hectares).

241
245 ities on seven allotments, were intercropped in only one case; this was with manioc.

241
245 The only other cases of commercial intercropping were one case where capsicum and green beans were planted together and another where cantaloupes (meleni maka) were planted with manioc.

241
178 Although intercropping, as part of commercial cropping, is discouraged, this practice continues on bush allotments because emphasis on subsistence production is still great and commercial crops are generally of secondary importance.

Important Tree Species

241
245 A considerable number of important tree species are either cultivated or protected on bush allotments throughout Tongatapu.

Coconut Palms

241
245 In the case of coconut palms, estimated cover was
125 used rather than counts of individual trees. The intervals
128 used for estimating cover were: 100%, 75%, 50%, 25%, 10%, 5% and 0% (see Appendix A). A Cover was defined as being 100% where palms were planted densely enough to total about 60 per acre (150 per hectare). The head of the Coconut Replanting Scheme considered this to be a fair estimate of the number of palms which, if planted throughout an allotment, would provide optimum yields (Liyanage, D.V., 1971, personal communication). Although individual

A [See Category 125, pp. 350-358--Analyst.]

241 palms were not counted as part of the survey, after the
245 completion of the survey, the palms on 16 of the sample
128 allotments were counted to determine the accuracy of the
125 estimates (Table 36).

241 Table 36. Inventories of coconut palms on 16 selected
245 bush allotments and the corresponding survey estimates.

Allotment No.	Acreage	(Hectares)	Estimated Coverage	Estimated Number	Actual Count
1	7.58	(3.07)	25%	115	141
2	8.25	(3.34)	75%	375	336
3	8.26	(3.34)	75%	375	354
6	6.41	(2.59)	50%	194	286
7	8.00	(3.24)	25%	121	172
8	4.22	(1.71)	25%	64	116
9	8.47	(3.43)	25%	128	234
10	8.36	(3.38)	50%	253	245
12	4.76	(1.93)	75%	216	211
23	8.25	(3.34)	25%	125	135
27	5.01	(2.03)	100%	303	427
33	4.10	(1.66)	50%	124	169
34	6.22	(2.52)	75%	376	296
59	8.27	(3.35)	75%	376	452
75	8.25	(3.34)	25%	125	155
77	8.25	(3.34)	10%	100	70

241
245
[654] Only 56 of the 101 sample allotments had recently planted coconuts. The median coverage for these allotments was only 25 percent. Because of senility and declining productivity of most palms on Tongatapu, the Coconut Replanting Scheme has subsidized the planting of new palms. Although a majority of allotments had some replanted palms, in very few instances were they well maintained. Nevertheless, there seemed to be sufficient replanting to insure the coconut palm's future as the dominant tree and most valuable plant on the bush allotments.

Fruit Trees

In addition to coconut palms, there were 25 species of fruit trees among the plant associations on the 101 [125] sample bush allotments(Table 38). For most species, numbers of individuals were tabulated, but individual Citrus species were difficult to differentiate and only presence or absence was noted.

The most common trees were mango (Mangifera indica), citrus trees (Citrus spp.), tava(Pometia pinnata), breadfruit or mei (Artocarpus altilis) and Tahitian chestnut or ifi (Inocarpus edulis), all of which were present on over 50 percent of the sample bush allotments. In most cases, these trees are protected and preserved during the clearing [313] of secondary vegetation for cultivation. However, there is a growing tendency to utilize many of these important tree crops for firewood and timber.

137 Among the species that were most favored for milling are:
313 tavahi (Rhus taitensis), toi (Alphitonia zizyphoides), tangato (Pleogynium solanderi), teiie (Terminalia catappa), feta'u (Calophyllum inophyllum), fao (Ochrosia oppositifolia), mo'ota (Dysoxylon forsteri), ma'ama'alava (Elaeocarpus tonganus), and kotone (Myristica hypargyraea) (Government of Tonga, 1961: 13).

In addition to lumbering, the need for firewood has [438] also made heavy demands on the tree population. One of the major items sold at Talamahu Market in Nuku'alofa is firewood and on one Saturday the following species were being sold (starting with the most abundant): tongo (Rhizophora spp.), sialemohemohe (Leucaena leucocephala), koka (Bischofia javanica), toi (Alphitonia zizyphoides), loupata (Macaranga harveyana), tavahi (Rhus taitensis), ngatata (Elattostachys falcata), ifi (Inocarpus edulis), tava (Pometia pinnata), mango (Mangifera indica), and orange (Citrus sinesis).

Nature of Fallow Areas

241 The survey of 101 sample bush allotments was also
● 125 concerned with the extent, age and species composition of fallow vegetation. Prior to the survey, selected Tongan farmers were asked about the ages of different fallow areas and within each area the plant species were noted. This showed that a reasonably accurate estimate of the length of the fallow period could be based on species composition

241 (Table 40). During the survey, by using combinations of
125 species, each portion of fallow vegetation was classified according to its approximate age; an estimate of the area was made by pacing; and the species composition was recorded. The age classes that were used in the survey were:
241 1, 2, 3-5, 5-10, and over 10 year fallow. There is of
128 course considerable overlap of species between age classes, and in different areas of the island different species may be dominant in a given age-class fallow association (Table
241 40). For example, in parts of the Hihifo or Western Dis-
128 trict, an area of 3-5 year fallow might have Lantana
137 camara, Psidium guajava, and Paspalum conjugatum as dominants; areas of 3-5 year fallow in Vahe Loto or the Central District might have Panicum maximum and Indigofera suffruticosa as dominants whereas an area of the same age-class in the Hahake or Eastern District might have Leucaena leucocephala as the dominant. Finally, the age-class intervals are not equal because, as the time of fallow increases, it becomes increasingly difficult to estimate the length of fallow accurately.

241 Extent of Fallow Land

The combined area for all fallow age-classes was 573 acres (232 hectares) or 71 percent of the total sample area
241 (Table 41). This is evidently a slight exaggeration,
128 because this estimate plus those for area of cultivated land and pasture totaled 851 acres, 6 percent above the

[TEXT CONTINUED ON PAGE 278]

241 actual total acreage of the 101 allotments.
128 Age of Fallow Land

241 Approximately half of all land on the sample allot-
[311] ments had been under fallow for five years or less. A very low percentage of the sample acreage had been under fallow for over ten years, mostly uncultivable littoral or
241 swamp forest. Of the non-swamp areas under fallow for ten
137 years or over, only 3 acres had dense forest stands and the balance had open secondary forests and thickets of Lantana camara or Psidium guajava. Fallow periods are too short for regeneration of the tropical lowland forest.

Species composition

The survey of the species comprising secondary vegetation attempted to determine both frequency of occurrence and dominance (Table 42).

241 These data are not highly accurate, for two reasons:
137 firstly, most allotments were surveyed only once and the
125 species composition of early pioneer species might vary
128 considerably depending upon either the season or the time elapsed since a plot had been cleared for cultivation, weeded, or harvested; and secondly, in the latter stages of the survey, the author was able to recognize non-dominant species, which might have been overlooked during the earlier stages of the survey.

241 Many weedy species were present on at least 75 percent
137 of the sample allotments (Table 42). Some of them, such as

241
137

leucocephala have made traditional hoe culture more difficult and have encouraged the use of the plow. On the other hand P. maximum is a useful pasture grass; P. guajava an edible fruit; and L. leucocephala is a source of livestock feed, firewood, and timber for general construction purposes, and its seeds are made into necklaces and other handicraft items. Others have proved of considerable utility: Cassia tora, Phaseolus semierectus, and Crotalaria mucronata, improve soil fertility; Sonchus oleraceus, Solanum nigrum, and Portulaca oleracea are often eaten as green vegetables; Bidens pilosa, Oxalis corniculata, Achyranthes aspera, and Centella asiatica are used medicinally; and Coleus amboinicus and Canna indica are used for scenting coconut oil and in the preparation of seed necklaces, respectively.

Most of these species seem to depend on man not only for their introduction but also for their continuing existence. By their very nature as secondary vegetation species, they depend largely upon man to open up suitable habitats. As the Tongan farmer removes the few remaining stands of native vegetation, these secondary species should become increasingly dominant.

241
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Agricultural Practices and Conditions

Inventories were also conducted of selected agricultural practices and conditions affecting the nature of plant assemblages on bush allotments. These included:

241
125 condition of crops, use of green manure or mulching, methods of clearing for cultivation, presence of agricultural improvements (such as houses or shacks, wells, transportation networks and fencing), and presence of livestock.

In evaluating husbandry practices associated with subsistence crops, manioc was treated separately, because
241 it generally requires less care. Of 81 sample allotments with subsistence crops other than manioc, 50 were well weeded, 19 unweeded, and 3 overtaken by bush. On 75 allotments with manioc, 3 were weeded and mulched, 14 well weeded, 46 unweeded, and 12 overtaken by bush. Yams, sweet potatoes, and plantains were generally well weeded; taro constituted the great majority of subsistence crops, apart from manioc, which were unweeded or overrun by bush. Taro requires little care and can compete with weeds and secondary vegetation. Manioc requires even less care and in only 17 of 75 cases was it well weeded; in 3 of these it was mulched with Sorghum halepense and in the remaining 58 it was unweeded or overtaken by bush.

Of 31 allotments containing commercial crops, 26 were well-weeded, 6 unweeded, and 2 overtaken by bush. Of the 6 unweeded commercial plots, 4 were banana plots on the verge of being unsuitable for export while the other two were pineapples and a vegetable garden with diseased bell peppers (Capsicum annuum) and green beans (Phaseolus vulgaris). In two cases pineapple patches were completely overtaken by

CHAPTER V

PLANT ASSOCIATIONS AND AGRICULTURAL PRACTICES ON TOWN ALLOTMENTS.

125 Data were collected during a survey of 192 town allotments, 113 in Nuku'alofa and 79 in the rural villages of Fo'ui - Ha'avakatolo (20), Niutoua (12), 'Utulau (24) and Fua'amotu (16) (Figure 3).A

351 342 343 Town allotments on Tongatapu average about one-half acre or less and usually contain a sleeping house (fale mohe) and, depending on the type and size of household, a number of other structures, including separate kitchens (peito), other smaller sleeping houses (fale mohe), out-

351 houses (fale vao), and washhouses. (Fale kaukau). Other improvements may include fences, water supply systems, and

351 241 livestock pens. The vegetation complex ranges from almost untended to highly cultivated subsistence and ornamental gardens.

241 128 In the discussion of gardens on bush allotments, the acreage of different crops was considered; however, owing to the limited cultivable area on town allotments, only the presence and relative abundance of crops and important tree species will be discussed. No consideration will be given here to commercial crops and fallow vegetation because they occupy negligible areas on town allotments.

A[See Category 116, p. 14--Analyst.]

125

Appendix A. Inventory scheme used for survey of bush allotments ('api 'uta) on Tongatapu.

OVERSTORY SPECIES AND OCCURENCE

COCONUTS

1. Percent Coconuts (Bearing)

1. 100%
2. 75%
3. 50%
4. 25%
5. 10%
6. 5%
7. 0%

a. in rows
b. randomly

2. Percent Coconuts (Replanted)

1. 100%
2. 75%
3. 50%
4. 25%
5. 10%
6. 5%
7. 0%

a. weeded
b. underplanted
c. burned
d. unweeded
e. dense bush

FRUIT TREES

3. Citrus Trees

1. 10+
2. 5 - 9
3. present
4. absent

4. Lemani

1. present
2. absent

5.* Moli kai
6.* Moli Peli
7.* Moli Veikeli
8.* Moli Tonga
9.* Laimi
10.* Moli Uku
11.* Kola
12.* Other Citrus
13. Mango

1. 10+
2. 5 - 9
3. present
4. absent

14.* Ifi
15.* Avoca
16.* Tava
17.* Mei
18.* Vi
19.* Fekika
20.* Tamaline
21.* Telie
22.* Guava
23.* 'Apele Initia
24.* Fekika palangi
25.* Fiki palangi
26.* Apu
27.* Piisi
28.* Apele Tonga
29.* Apele Kai
30.* Koko

●125

OTHER USEFUL TREES

31. Koka

1. 25+
2. 10-24
3. present
4. absent

32.* Tavahi
33.* Fau
34.* Ngatae
35.* Tuitui
36.* Loupata
37.* Nonu
38.* Toi
39.* Mapa
40.* Heilala
41.* Ahi
42.* Hehea
43.* Masi Aukava
44.* Vavae
45.* Malólo
46.* Ngatata
47.* Nukonuka
48.* Ovava
49.* Fotulona
50.* Puataukanave
51.* Mohokoi
52.* Kotone
53.* Lalatahi
54.* Touhuni
55.* Fao
56.* Mo'ota
57.* Langakali
58.* Fiki
59.* Fehi
60.* Fo'ui
61.* Milo
62.* Huni
63.* Pua Tonga
64.* Feta'anu
65.* Tongolei
66.* Tongota'ane
67.* Hangale
68.* Kanume
69.* Toto
70.* Volovalo
71.* Koli
72.* Lopa
73.* Pipi Failolo
74.* Puko
75.* Ma'ama'alava
76.* Hea
77.* Takafalu
78.* Tangato
79.* Tatangia
80.* Futu
81.* Lekileki
82.* Maile
83.* Te'ete'emanu
84.* Oke
85.* Toa
86.* Fē
87.* Kalosipani
88.* Manaui
89.* Filimoto
90.* Sipaisi
91.* Feta'u
92.* Fekika Vao
93.* Kau
94.* Masi Ata
95.* Masi Koka
96.* Mangele
97.* Kalaka
98.* Kakala'uli
99.* Kulukulu
100.* Ahi Vao
101.* Pulukamu
102.* Sita

125

103.* Te'epilo'amaui 104.* Manonu 105.* Sita Palangi

106.* Malamala'afonua

USEFUL PLANTS (limited or no cultivation)

107.* Longolongo

1. present
2. absent

108.* Si

109.* Kava Aukava

110.* Ango (enga)

111.* Angoango

112.* Loufusi faikakai

113.* Polo Tonga

114.* Pasiole

115.* Uhi

116.* Temata Vao

117.* Polo Pifisi

118.* Tamatama

119.* Tevunga

120.* Kaloni

121.* Hana

122.* Polokai

123. Pitu

1. stands
2. present
3. absent

124.* Kofe

125.* Kaho

126. Teve

1. present
2. absent

CULTIVATED PLANTS

127. % Cropped

1. 100.00%
2. 93.75%
3. 87.50%
4. 81.25%
5. 75.00%
6. 68.75%
7. 62.50%
8. 56.25%
9. 50.00%
10. 43.75%
11. 37.50%
12. 31.25%
13. 25.00%
14. 18.75%
15. 12.50%
16. 6.25%
17. 0.00%

128.* % Pasture

129.* % Subsistence

Cropping Breakdown.

130. Yams

1. 100
2. 87.50%
3. 75.00%
4. 62.50%
5. 50.00%
6. 37.50%
7. 25.00%
8. 12.50%
9. 6.25%
10. 0.00%

a. alone
b. kape
c. kape, taro
d. taro
e. K,T, Hopa
f. K,H
g. corn
h. talo Tonga
i. melons
j. Kape maho'a
k. K, corn
l. T. Hopa
m. K,H, banana
n. K,T, ufilei

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131.* Taro Tonga

a. alone
b. H,K,T
c. H,K
d. H,T
e. T,H
f. T
g. K, hiapo
h. hiapo
i. kava
j. ufilei, faina

132.* Taro

a. alone x. w/Tt
b. K
c. K,H
d. H
e. K,H,S
f. H,S
g. K,Kumala,Tt
h. H,hiapo
i. hiapo
j. K, Tt
k. K,H,Ku
l. hina

133.* Kumala

a. alone
b. kape
c. siaine
d. taro
e. K, Hopa
f. hiapo
g. manioke

134.* Manioke

a. alone
b. K
c. H
d. Rock melon
e. siaine
f. hiapo
g. faina

135.* Ufilei

a. alone
b. K,H,S
c. K,H.T
d. T
e. K,T,S

136.* Maho'a'a

a. alone
b. K,Y,T

137.* Plowed and Not Planted

138.* Burned and Not Planted

139.* Bananas

a. commercial
b. still in tact
c. remnants
d. just planted

140.* Hiapo

a. unweeded
b. overrun by bush
c. underplanted
d. under bananas

141. Kape

1. alone
2. remnants
3. with others
4. absent

a. *when alone see No.130 for %

142. Hopa

1. present
2. absent

a.* when alone see No.130 for %

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143.* Pata

144.* Siaine

145. Kava

1. 15+
2. 5 - 14
3. present

a.* when alone see 130 for %.

146. Louakau

1. 25+
2. 10 - 25
3. present
4. absent

a.* when alone see No. 130 for %.

147. Lesi

1. In Rows
2. 10+
3. present
4. absent

148. Pele

1. 20+
2. 5 - 19
3. present
4. absent

149.* Tō

150. Faina

1. Rows
2. 20+
3. present
4. absent

151. Onioni Tonga

1. rows
2. present
3. absent

152. Hina

1. present
2. absent

153.* Pasione

154.* Vavae tonga

155.* Moengalō

156.* Kofi

157.* Tapaka

a* if alone see No. 130 for %.

158. % Commercial Crops see No. 126 for %.

BREAKDOWN

159. Bananas

1. 100.00%
2. 87.50%
3. 75.00%
4. 62.50%
5. 50.00%
6. 37.50%
7. 25.00%
8. 12.50%
9. 6.25%
10. 0.00%

a. alone
b. just planted
c. not bearing
d. Taro
e. Manioka
f. Yams
g. Hiapo
h. 'Ufilei, kape

160.* Watermelon

a. alone
b. 'ufi

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161.* Pineapple

a. commercial
b. no evidence of commercial.

162.* Peanuts

a. remnants

163.* Rock melons

164.* Vanilla

165.* Garden Vegetables

a. commercial
b. not commercial

BREAKDOWN

166. Tomatoes

1. commercial
2. present
3. absent

167.* Cabbage

168.* Chinese Cabbage

169.* Bell Pepper

170.* Onions

171.* Lettuce

172.* Corn

173.* Cucumbers

174.* Carrots

175.* Beans

176.* Radishes

177.* Silverbeets

177a.*Eggplant

BUSH FALLOW COMPOSITION

178. 1 year Fallow

See No. 127 for %.

179.* 2 year Fallow

180.* 3 - 5 year Fallow

181.* 5 - 10 year Fallow

182.* 10+ year Fallow

a. bush
b. lagoon
c. coastal

x. no lantana, guava

y.w/ lantana, guava

183.* Sialemohemohe

a. included in 179
b. included in 180
c. included in 181

184.* Safa

included in

a. 179

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b. 180
c. 181
d. 182

185.* Kola

included in

a. 178
b. 179
c. 180
d. 181

186. Planted Pini

1. ¼+ acres
2. present
3. absent

CROPPING PRACTICES + CONDITION OF ALLOTMENT

187. Condition of Subsistence Crops (Apart from Manioke)

1. well weeded
2. unweeded
3. overtaken by bush

188. Condition of Manioke

1. weeded + mulched
2. well weeded
3. unweeded
4. overtaken by bush

189. Condition of Commercial Crops.

1. weeded
2. unweeded
3. overtaken by bush

190. Abandoned Bananas

1. present
2. absent

191. Wasted coconuts

1. excessive
2. present
3. none

192. Rat Damage

1. evident
2. not evident

193.* Burning

194.* Plowing

195. Soil Types

1. Kelefatu
2. Tau'one
3. Ano

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OCCURENCE OF ANIMALS

196. Pigs

1. Numerous Penned
2. Few Penned, 1 - 3
3. Tied to trees
4. Free
5. None

197. Cattle

1. Grazing
2. Tried to trees
3. None

198.* Horses

199.* Goats

200. Chickens

1. numerous penned
2. numerous free, 5+
3. few, 0 - 5
4. absent

201. Ducks

1. present
2. absent

IMPROVEMENTS

202. Paved Roads Bordering

1. yes
2. no

203.* Dirt Roads Bordering

204. Roads through 'api

1. more than 1
2. 1
3. none

205. Paths through 'api

1. many 3+
2. 1 or 2
3. none

206. Barbed Wire Fencing

1. good condition
2. poor condition
3. partly
4. none

207. Dwellings

1. Permanent Residence
2. small shack
3. none

a. 1 acre +
b. ½ acre
c. ¼ acre
d. house only

208. Copra Drier

1. present
2. absent

a. not used

209. Water

1. Well
2. Tank
3. None

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MAJOR WEED SPECIES OCCURENCE

210. Kuava

1. Dominant or Co-dominant in some areas
2. Abundant
3. Present
4. Absent
5. Don't know.

211.* Talatala

212.* Mo'osipo

213.* Akauveli

214.* Misimisi

215.* Ikuikumã

216.* Pakaka

217.* Mateloi

218.* Kaningi

219.* Fisipuna

220.* Vailima

221.* Hulufe

222.* Pakopako

223.* Pakopako'ae kuma

224.* Tono

225.* Akataha

226.* Kihikihi

227.* Te'ehoosi

228.* Te'epulu

229.* Te'ekosi

230.* Aka

231.* Vaine ae kuma

232.* Vaine initia

233.* Vaine kai

234.* Hoi

235.* Puakatau

236.* Saafa

237.* Kola

238.* Hefa

239.* Salapona

240.* Laufale

241.* Longolongo 'uha

242.* Tisaipale

243.* Ate

244.* Valae

245.* Fisi'uli

246.* Pula

247.* Fue

248.* Fau

249.* Pini Kulokula

250.* Sialemohemohe

251.* Filo

252.* Lautolu'uta

253.* Lautolu tahi

254.* Mohokuapopoa

255.* Lauveveli

256.* Miniti

257.* Mohuku Siamane

258.* Sakisi

259.* Tamole

260.* Tutu'uli

261.* Tutu hina

262.* Piho'a

* Designates same classification as previous item.

125 Appendix B. Inventory sheet used for the survey of town allotments ('api kolo) in six villages on Tongatapu.

CATEGORY	LOT NO.	CATEGORY	LOT NO.	CATEGORY	LOT NO.
1 F.Tonga		44 Onioni T		87 Siaine T	
2 F.palangi		45 Pasione		88 Tamaline	
3 Large wood		46 Pele		89 Tava	
4 Large brick		47 Polofifisi		90 Telie	
5 Sm wd/tin		48 Si (kai)		91 Vi	
6 Tongan fale		49 Talo T		92 Vine	
7 1ml. Nuk.		50 Talo f.		93 Ahi	
8 -1 ml Nuk.		51 Temata vao		94 Fa	
9 1 ml Nuk.		52 To		95 Fao	
10 Not in Nuk		53 Ufi		96 Fau	
11 Wood fence		54 'Ufilei		97 Feta'anu	
12 U. tala		55 Vaine		98 Feta'u	
13 Tanetane		56 Vaine kai		99 Fiho'a	
14 Kaute		57 Niu		100 Fiki	
15 K'apusi		58 'Apele 'I		101 Fotulona	
16 Paipa		59 'Apele T		102 Fo'ui	
17 Si		60 'Apele p		103 Hangale	
18 Ngatae		61 'Apele kai		104 Hea	
19 Fiki		62 'Avoka		105 Hehea	
20 F/peito		63 Fekika kai		106 Heilala	
21 F/kai		64 Fekika pal		107 Huni	
22 F/malolo		65 Fuamelie		108 Kalosipani	
23 F/kaukau		66 Hopa		109 Kanume	
24 WHO water		67 Ifi		110 Koka	
25 Well		68 Kola		111 Koli	
26 Tank		69 Kuava		112 Kotone	
27 No water		70 Laimi		113 Lalatahi	
28 Moa/f'to		71 Lemani		114 Langakali	
29 Moa		72 Lesi		115 Lekileki	
30 Pato		73 Lopa		116 Loupata	
31 Pulu		74 Mamae		117 Maile	
32 Hoosi		75 Mango		118 Malolo	
33 Puaka/pen		76 Misipeka		119 Manaui	
34 Puaka/tie		77 Mei		120 Mangele	
35 Puaka/hol		78 Moho		121 Mapa	
36 Kosi		79 Moli kai		122 Masi'auka	
37 Kuli		80 Moli peli		123 Masi koka	
38 Pusi		81 Moli tonga		124 Mohokoi	
39 Paina		82 Moli uku		125 Mohokoi H	
40 Kape		83 Moli v'keli		126 Mo'ota	
41 Kofi		84 Pata		127 Nonu	
42 Kumala		85 Siaine Fisi		128 Nukonuka	
43 Manioke		86 Siaine Ha		129 Ngatae	

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Appendix B continued.

CATEGORY	LOT NO.	CATEGORY	LOT NO.
130 Ngatata		177 Pitu	
131 'Olive		178 Si (sisi)	
132 'Ovava		179 S.matalateau	
133 'Ovava F		180 S.tonga	
134 Pipi		181 Sinisa	
135 Piu		182 Tamatama	
136 Puatonga		183 Tapahina	
137 Pukovili		184 Teuila	
138 Sinamoni		185 Tevunga	
139 Sipaisi		186 Tofua	
140 Tangato		187 Vavae palangi	
141 Tatangia		188 Falahola	
142 Tavahi		189 Kapisi	
143 T'T'manu		190 Kapisi siaina	
144 Toa		191 Kaloti	
145 Toi		192 Kiukamipa	
146 Tongo		193 Hina	
147 Toto		194 Lasipeli	
148 Touhuni		195 Letisi	
149 Tuitui		196 Meleni	
150 Tutu'uli		197 Meleni maka	
151 Vavae		198 Onioni	
152 Volovalo		199 Paingani	
153 Fekika vao		200 Piini	
154 Te'elango		201 Piisi	
155 Ango		202 Temate	
156 Angoango		203 Koane	
157 Ate		204 Pinati	
158 Hana		205 Faleniu	
159 Hiapo		206 Tutua	
160 Kaho		207 'Api 'uta	
161 Kava		208 Saliote	
162 K.'aukava		209	
163 K'k'ulie		210	
164 Kie		211	
165 Kofe		212	
166 Kuta		213	
167 Lautolu t		214	
168 Lolie			
169 Longolongo			
170 Loufao			
171 Manioke k			
172 Misimisi k			
173 Moangalo			
174 Mahoa'a			
175 Paaiole			
176 Paongo			

Selected questions:

a. Does the household have access to a bush allotment; if so, where? _____

b. How do they get to their bush allotment? _____

c. What is the occupation of the head of the house? _____.

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Appendix C. Copy of household questionnaire administered to 150 households in nine (9) Tongatapu villages.

Household Questionnaire: Subsistence Agriculture

Location: _____ Number of Visits ___, ___, ___.

Sample No.: _____

Name of Head of Household: _____

I. Number and type of structures:

A. Houses Other structures

Large European	Poor quality European	Part European	Tongan	Peito	Falevao	F.kau-kau
_____	_____	_____	_____	_____	_____	_____

B. Type of Timber:
European _____ Tongan _____ Both _____

II. Number and Sex of Household members:

Number males:_____ Number females:_____Total:_____

III. Information on Males over 16 years of age:

Name	Age	Relation to head	Full-time farmer	Part-time farmer	Earner	Unemployed

IV. Information on Wage-earning females:

Name	Age	Occupation

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V. Land-tenure by household (Tongatapu):

Type of land and tenure:	Number	Estate*	Acreage	Location
A. Registered 'api kolo				
B. Unregistered 'api kolo				
C. Temporary occupancy (kole)				
D. Leased or rented				
A. Registered 'api 'uta				
B. Unregistered 'api 'uta				
C. Temporary occupancy (kole)				
D. Leased or rented				

* Crown (name), Noble (name), or Government Estates

VI. Land-tenure by household (other island groups)

Type of land and tenure:	Number	Estate*	Acreage	Location	Other information
A. Registered 'api kolo					
B. Unregistered 'api kolo					
C. Temporary occupancy (kole)					
D. Leased or rented					
A. Registered 'api 'uta					
B. Unregistered 'api 'uta					
C. Temporary occupancy (kole)					
D. Leased or rented					

* Same classification as V.

VII. Location of residence

On town allotment _____
Permanently on bush allotment _____
Temporarily on bush allotment _____

VIII. Information on Water Supply

A. Type of water supply on 'api kolo

well _____ private pipe _____
metal tank _____ village W.H.O. _____
cement tank _____

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B. Source of water used on 'api 'uta

well _____ transported _____
metal tank _____ other _____
cement tank _____ no water used _____

IX. Soil Information

A. What kind or kinds of soil do you have on your 'api? Are they good or bad soils? What crops are they good for?
1) _____ 2) _____
3) _____.

B. Were the soils better in the past? ____. If so how do you know? _____

C. Which "bush fallow" plants (vao) mean that the soil is good? _____
Good for what crops? _____

D. Which "bush fallow" plants mean that the soil is bad (kaka)? _____

E. What are three (3) ways you use to keep the soil good? 1) _____;2) _____;3) _____.

X. Transportation

A. 'Api kolo is in _____; 'api 'uta is in _____, they are _____ miles apart.

Item	Do you own	Used to go to 'uta
Truck		
Bus		
Car		
Minimoke		
Motocycle		
Bicycle		
Saliote		
Horse		
Walk		
Ve'etolu		

XI. Livestock

A.

Type	Adult	Young	In bush	In town	Tied	Fenced	Free	Penned	Other
Horses									
Cattle									
Pigs									

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Goats
Chickens
Ducks

B. Feed: What do the different types of livestock eat?

Type	Types of food	From where	Do you buy some? Where?
Horses			
Cattle			
Pigs			
Goats			
Ducks			
Chickens			

C. Have you bought butchered meat from other Tongans this year? _____?
horsemeat ____; beef ____; pork ____; goat ____; chicken ____; duck ____. (How many times?)

D. Have you purchased any meat at the Government? ____.
If so, what? _____

E. How often do you purchase "sipi"? Times/week ____;
Times/month ____.

F. Do you ever buy any meat from the big stores in Nuku'alofa? _____ If so, what kind of meat? _____ Is it for any special purpose? _____.

G. Do you own N.Z. chickens? _____. Meat birds _____ or layers _____? Purchased where? _____
How much? _____

H. Do you belong to the Pig Subsidy Scheme? _____.
The Poultry Subsidy Scheme? _____. The Cattle Subsidy Scheme? _____ Are these schemes good or bad? _____. Why? _____

XII. Labour

A. Number of hours/week during "to ta'u" (not counting work done by kautahas or tou ngaues, e.g. family and non-paid friends.)

Name	Relation to head of household	Number of hours per day per week						Total
		Mon	Tue	Wed	Thur	Fri	Sat	
Head of household								
2)								
3)								
4)								

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B. Do you belong to a "kautaha tou ngaue"? ____. If yes, how many members are in it? ____. How many days a week do they work? ____. On how many 'apis do they work each day? ____. How many hours on each 'api? ____. How many hours/day? ____. Does the "tou ngaue" work all year long? ____. If not, during which seasons or months does it work? _____. Does it work for pay on 'apis of people who are not members? ____. If so, how much do they charge per hour? _____. Are most of the members from the family? ____, kainga? ____ or village ____?

C. Do you pay any kautahas to work on your land? _____.

D. What kind of work do they do? _____.

E. At what time of year do you need this kind of labor? _____.

F. Have you been a member of a "toutu'u 'ufi" this year? ____. If yes, how many members? ____. Was it a church group ____, family group ____, or a village group ____? Have you been a member of a "toutu'u 'ufi" in the past five (5) years? ____. After the yams were harvested was the land allowed to return to bush? ____. If not what was planted after the yams were harvested? _____.

H. Do you belong to a "kautaha le'ovao"? _____.

I. What are the six most important jobs for women?
1) _____; 2) _____; 3) _____
4) _____; 5) _____; 6) _____.

J. Do the women "vau koka"? _____. How many go at a time? _____. Do the men ever help? _____.

K. Do any of the women belong to or participate in a "koka'anga"? _____. How many times per year? _____. How many people participate? _____.

L. Do any of the women join in a tou langanga? _____. How many times per year? _____. How many participate? _____.

M. Do any of the women participate in a tou lalanga? _____. How often? _____. How many participate? _____.

N. Are these craft groups generally made up of women of your family? _____, village? _____, church? _____ or special group? _____.

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XIII. Machinery and Tools

A. Do you own a tractor? ____. If yes, how much did it cost? ____ (new) or ____(used). How often do you use it on your own 'api? ____.(times a year.) Do you use it on other family members' or friends' 'apis for no pay? _____. How often? _____. How much do you charge? _____ (per acre). How much money did you make from plowing last year? ____. Do you own a plow for your tractor? ____. Price? ____. A disc harrow? ____ Price? ____. A trailor? ____ Price? ____. Any other attachments? ____ Price? ____. If you use these on other's 'apis, how much do you charge? ____. How often? ____.

B. Have you had someone else plow your land? ____. Who? _____. How often? _____. What was the cost? _____ per acre. Did you have it disced? ____. Cost? _____. Anything else done to it? _____? Cost? _____.

C. Do you own a sprayer? ____. Hand pump? ____ or machine ____? Have you ever borrowed a sprayer? ____. From whom? _____ Have you ever rented one? ____. From whom? _____. Have you ever paid another person to come and spray your crops? _____. Who? _____. Cost? _____. Has the Ag. Dept. or T.P.B. ever sprayed your crops for you? _____. What crops? _____. How often? _____. Was it often enough and did they do a good job? _____.

D. Is plowing good for the soil? _____. Reasons _____ _____.

E. Ownership of hand-tools

Type	Number	Borrow	Use in garden
Huo lafalafa			
Huo keli (sipaiti)			
Huo langa			
Toki palangi			
Toki tonga			
Helepelu			
Kavolo			
Laiki			
Hele hihiniu			

XIV. Other Inputs

A. Do you use fertilizer? ____. On what crops? _____. Where do you get the fertilizer? _____. Do you pay for it? _____. How much? _____. Is it good for the crops and the soil? ____. Why? _____

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B. Do you use insecticides? ____. On what crops? _____.
Purchased where? _____. Cost? _____.
Are insecticides good or bad? _____. Why? _____.

C. Do you use fungicides? ____. On what crops? _____.
Purchased where? _____. Cost? _____.
Are fungicides good or bad? ____. Why? _____.

D. Do you buy any seeds or are you given any seeds?
_____. Bought? _____. Gift? _____. What crops?
_____. How much? _____. Where from? _____.
Cost? _____.

E. Do you buy anything else for your farming? _____.
Explain (use, origin, cost, amount, etc.) _____
_____.

XV. Information on fallow periods and multiple cropping

A. Which crops do you plant more than once in a row on the same plot?

Crop	Often	Seldom	Never
Manioke			
Yams			
Talo futuna & tea			
Talo tonga			
Kape			
Kumala			
Hiapo			
Pineapple			
Melons			
European veget.			
Bananas			

B. How long do you usually let the land rest in bush before you plant again? _____. Is it the same for all plants?_____. Longer in the past? _____.

C. How long do you keep crops on it before you let it rest? _____. What is usually the last crop you plant before you let the land rest? _____.

XVI. Planting materials.

A. Where do you get your planting material?_____
_____.

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'Ufi T.tonga Talo Kum Man Sia Hopa Pine Fain Veg

Own 'api _____

Family _____

Other buy _____

Where buy _____

B. Are there any types of planting materials (pulopula, seeds, etc.) that are difficult to obtain? _____. Why? _____ How do you obtain them? _____ _____.

XVII. Problems

A. What are the four (4) worst weeds?

1) _____
2) _____
3) _____
4) _____

B. What are the four (4) most harmless weeds?

1) _____
2) _____
3) _____
4) _____

C. What are the three (3) worst pests of coconuts?

	Pests	Method of control (if any)
1)	_____	_____
2)	_____	_____
3)	_____	_____

D. What are the three (3) worst pests of bananas?

	Pests	Method of control (if any)
1)	_____	_____
2)	_____	_____
3)	_____	_____

E. What are the five (5) worst pests of all crops?

	Pests	(Crop(s) attacked
1)	_____	_____
2)	_____	_____
3)	_____	_____
4)	_____	_____
5)	_____	_____

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F. What are the five worst diseases that attack crops?

	Disease	Crop(s) attacked
1)	_____	_____
2)	_____	_____
3)	_____	_____
4)	_____	_____
5)	_____	_____

G. Do you have any problems with theft? _____. What are the things that are most often stolen? _____. Do you mind if people come and take things from your 'api? _____.

H. Which plants are most bothered by drought? _____ _____ Have there been any bad droughts in the last few years? ____. When? ____. Have you heard of or can you remember any very bad droughts in the past? _____. What happened? _____.

I. Have any of your crops ever been damaged by heavy winds or hurricanes? _____. When? _____. Which crops or trees were damaged the most? _____.

J. Have any of your crops been damaged by salt spray from the ocean? _____. When? _____. What crops were damaged? _____.

XVIII. Importance of Crops

A. Which five root crops (starches and including mei and fusi) do you like best? 1) _____ 2) _____ 3) _____ 4) _____ 5) _____ (start with the one which tastes the best).

B. Which root crops or other starches would you put on a pola for an important feast? 1) _____, 2) _____, 3) _____, 4) _____, 5) _____, 6) _____, 7) _____; for a small family or church feast? 1) _____, 2) _____, 3) _____, 4) _____, 5) _____, 6) _____, 7) _____.

C. What are the three (3) starches that you eat most often?

1) _____ 2) _____ 3) _____.

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XIX. Consumption Patterns

Item	Every day	Times/ wk.	Times/ mth.	Times/ yr.	Once eaten	Never
1) Fish						
2) Fingota						
3) Pork						
4) Beef						
5) Goat						
6) Horse						
7) Chicken						
8) Duck						
9) Eggs						
10) Bread						
11) Kapa pulu						
12) Kapa ika						
13) Sipi						
14) Sausage						
15) Dog						
16) Yams						
17) Kape						
18) Kumala						
19) Manioke						
20) Grn. bananas						
21) Rp. bananas						
22) Talo tonga						
23) Talo futuna						
24) Talo tea						
25) Grn. pata						
26) Rp. hopa						
27) Grn. pata						
28) Rp. pata						
29) Mamae						
30) Misipeka						
31) Mei s'son						
32) Ifi s'son						
33) 'Ufilei						
34) Corn						
35) Onions						
36) Oni. tonga						
37) Lesi						
38) Faina s'son						
39) Melons						
40) Tomatoes						
41) Cabbage						
42) Chinese cabb.						
43) Carrots						
44) Lettuce						
45) Cucumber						
46) Beans						

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Item	Every day	Times/ wk.	Times/ mth.	Times/ yr.	Once eaten	Never
47) Polo						
48) Lu						
49) Pele						
50) La'i kumala						
51) La'i manioke						
52) L'l'uha						
53) Polo kai						
54) Teve						
55) Mahoa'a T.						
56) Si						
57) To						
58) Fa						
59) Limu						
60) Niu						
61) Manioke tama						
62) Cat						
63) Flour						
64) Butter						
65) Tea						
66) Tea (moengalo)						
67) Coffee						
68) Cocoa						
69) Milk						
70) Sugar						

XX. General sources of money

Does someone in the household

1) Have a full-time job? ____
2) Have a part-time job? ____
3) Sell copra? ____
4) Sell coconuts? ____
5) Pack bananas? ____
6) Ship watermelons? ____
7) Ship other produce? ____
8) Sell food at the market? ____
9) Sell handicrafts (langafonua) ____
10) Sell handicrafts at mala'e? ____
11) Sell meat? ____
12) Sell fish? ____
13) Remittances from overseas? ____
14) Other ____

XXI. Means of saving, and capital accumulation

A. Do you have a bank account in Nuku'alofa? ____. In whose name? _____. Approx. amount in the bank _____.

B. Do you belong to a kautaha li pa'anga? ____. If so, how many members? _____. How often do they meet? _____. How much money do you put in during each meeting? _____. For what purposes are you saving the money? _____. Do they work well or not? _____. Why? _____.

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C. Do you belong to a revolving credit society where a person, at each meeting gets the money? _____. What is the name that Tongans give to this type of "kautaha"? _____. How many members? _____. How much does each member put in per meeting? _____. How is the money distributed? _____
_____
(e.g. is the money given to the different members in turn; or is a name drawn out of a hat; is a die thrown etc.) What is the money used for? _____.

D. Do you belong to any groups that help to save money for use in agriculture? _____. If yes, explain:
_____.

XXII. Expenditure

A. Name eight (8) things that you buy in the village "fale koloa"?
1) _____ 2) _____ 3) _____
4) _____ 5) _____ 6) _____
7) _____ 8) _____

B. Name five (5) things that you buy in the big "fale koloa" in Nuku'alofa? 1) _____ 2) _____
3) _____ 4) _____ 5) _____

C. Do you give money to:

1) Other family on Tongatapu? _____. If so, how much/yr? _____.
2) Family in other island groups? _____. If so, how much yr? _____.
3) To friends? _____. If so, how much/yr.? _____.
4) To the church? _____. If so, how much/yr.? _____.
5) To nobles? _____. If so, how much/yr.? _____.
6) To town officer? _____. If so, how much/yr.? _____
7) To others (specify)? _____. If so, how much/yr.? _____.

D. What are your four (4) most important needs for money? (list in order of preference).
1) _____ 2) _____ 3) _____ 4) _____.

XXIII. Relative importance of social obligations

A. With respect to your social obligations, which of the following is the most important unit?

1) Ki'i famili _____
2) Kainga _____
3) Church _____
4) Village _____

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XIV. Educational media

A. Do you have a radio? ____. Do you listen to "Man on the Land", the Saturday market report and other programs pertaining to the land? ____. Are these programs important or are they a waste of time? _____.

B. Do you listen to the Produce Board and Copra Board Reports on the radio? _____. Do you always hear them or have you failed to hear some important instructions about shipments, prices, etc. _____.

C. Do you read the "Chronicle" every week? _____. If not, why not? _____. Do you ever get any important information about farming from the Chronicle? _____. If so, what? _____.

D. How often do you go to the movies? _____. If less than once per month, how many times per year? _____.

E. Does the Ag. Dept. visit you? _____. If often, how many times per year? _____. If seldom, how many times per year? _____.

F. Have you ever read any books or pamphlets put out by the Ag. Dept.? _____. If so, how many and what were they about? _____.

XXV. Historical changes

A. Are there any changes in the types of crops grown today in Tonga when compared with the past? _____.

B. Any differences in farming methods? _____.

C. Any differences since W.W.II? _____.

D. Any change in the amount of things given away to friends and/or nobles etc.? _____.

E. What are the two most important things the government could do to improve farming for Tongan farmers?

1) _____ 2) _____.

XXVI. Addenda

A. Where do you get your firewood?

From allotment _____: From mkt. _____: From 'Eua ___
From others _____: From T.C.C. _____: From sawmill _____.

0125

B. What is your opinion of kautaha le'ovao?
_____.

C. How much do you pay per year in school fees?
_____.

D. Do you understand the land laws? _____.

E. Do you have electricity? _____(yes) _____(no)

F. Do you use a kerosene stove or wood burning stove?
_____.

G. Do you use only firewood (fefie)? _____ (yes)
_____ (no).

H. How often do women work on the 'api 'uta?
Often _____; Sometimes _____; Never _____.

I. Were the informants?
Very honest _____; Fairly honest _____;
Dishonest _____.

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184 are also differences among villages with respect to ecological setting, population density, and a number of social, political, and economic factors. Motulahi is particularly unlike most other villages in that there
162 is a very large number of people in the village. According to the census
361 of 1966, Motulahi's population numbered 1122, making it one of only
621 eight villages in the whole of Tonga with a population of more than one thousand people. At the same time, half of all the villages in Tonga had a population under three hundred. However, the population of all these small villages accounted for less than one fifth of the total population of Tonga, and only one quarter of all the people living in villages.

125 Before proceeding to examine the population of Motulahi, something should be said about the difficulty of making a statement about who the people of any village in Tonga *are*. My household survey was conducted intermittently, beginning early in January 1970 and continuing
[484] at intervals until about the middle of May. By the end of that period,
[166] some of the people who were enumerated earlier in the survey were no longer living in Motulahi or were still in the village but living in some other household, while others came to live in Motulahi only after I had
121 already surveyed the household in which they lived. Demographers commonly deal with these fluctuations by arbitrarily fixing on a particular date and enumerating the population present at that date. This suits their purpose of enumeration, but it is an intolerably arbitrary solution of the problem of ethnographic description (Carroll 1975a, Colson 1967). My lack of concern at that time for the demographic significance of the data I was collecting is revealed by the fact that I did not take the simple step of making an enumeration of the population present on one day. Instead, what I did was try to keep track of the people whose existence I was aware of, noting changes in household composition and migration in and out of the village. It was in considering how to deal with these data that I came to realize that population flux is not a difficulty that gets in the way of perceiving the demographic characteristics of the village but, instead, is a vital element of proper description of local organization in Tonga (Decktor Korn 1975). Again, since I gave no thought to the compilation of statistics on migration, I made no effort to ascertain exactly when these residential changes took place. What I wanted to determine was the reasons and circumstances that caused people to make their moves.

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For the present purpose of presenting a demographic profile of the village, I am taking the population of Motulahi to be the sum of the people who were enumerated in the course of the house-to-house survey (except that anyone enumerated more than once is counted only at the last household). People not living in a household at the time it was surveyed are not included here; to include them would inflate the population total and distort the age-sex proportions, since young adults are more mobile residentially than other segments of the population.

According to this enumeration, Motulahi had 1192 inhabitants in the early part of 1970. Of these people, 617 were male and 575 were female (see Table 1). A percentage breakdown of village population according to ten-year age categories indicates that more than half the population was under the age of twenty and over 90 % were under the age of fifty. This is similar to the age distribution within the national population at the time of the census of 1966. However, there was a higher percentage of persons in the 10—19 year-old group in Motulahi than in the nation at large, and this might be accounted for by the fact that it is fairly

Table 1. Population of Motulahi 1970, Enumerated by Sex and Age and Compared with the National Population (1966)

Age Group	Motulahi					National	
	Number			% (N = 1192)	Proportion of Males per 1000 Persons	% (N = 77,429)	Proportion of Males per 1000 Persons
	Males	Females	Total				
0—9	202	168	370	31.0	546	33.4	520
10—19	183	147	330	27.7	555	22.9	517
20—29	81	93	174	14.6	466	15.1	503
30—39	53	66	119	10.0	445	11.2	505
40—49	54	51	105	8.8	514	7.8	524
50—59	23	23	46	3.9	500	4.6	525
60—69	12	15	27	2.3	444	3.0	497
70+	9	12	21	1.8	429	1.8	466
Unknown	—	—	—	—	NA	0.2	NA
Total	617	575	1192	100.1	518	100.0	514

Sources: fieldwork survey; Fiefia 1968: 50—52.

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common for youngsters from the outer islands to be sent to live with a family on Tongatapu so that they can attend the better schools on the main island.

There is less similarity to national demographic characteristics when we examine the proportion of males in the population; that is, there are considerable differences between the figures for Motulahi and those for the population as a whole (see Table 1). The excess of males over females in the 10—19 year-old group might be accounted for by the fact that, while there is no overt sex discrimination in education opportunity, a boy's parents are more likely to make the effort involved in moving to live on the main island or sending their child to live there. The excess of females in the 20—29 and 30—39 year-old groups might be accounted for by the fact that men in those age-categories may be living away from the main island to earn a living on the land or in some job while the wife and children live where the children can take advantage of educational opportunities. However, I do not have a great deal of confidence in these explanations. The age-sex structure of the national population calls for further demographic investigation, and differences between the age-sex proportions for Motulahi and the nation as a whole could be accounted for by random variation.

Anomalies, Discrepancies, and Ethnographic Validity

Again, had I been interested in these matters at the time the data were collected, I would undoubtedly be in a better position now. For one thing, I would surely have been more careful in collecting data on people's age and checking the accuracy of these data. Then, I was usually content to record what I was told about a person's age at the nearest birthday; I seldom bothered to ask for the exact birth date, and there were few cases where the answer to my question about a person's age seemed so anomalous that I felt it necessary to probe beyond the first response. However, I now feel that the accuracy of my data on age must be regarded with some reservation, and of course this affects the value of other demographic data, particularly material relating to fertility. The assumption that the data on exact age are not accurate is the most likely explanation for the anomalous finding that only two young women in the village said to be under the age of twenty had already

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162 163 621 *Table 2. Maternal Age at the Birth of the First Child among Women of Motulahi (1970) Aged Fifteen and Over, and Compared with the National Census (1966)*

Age at Birth of First Child	Women of Motulahi							Tonga
	15—19 (N=64)	20—24 (N=58)	25—29 (N=35)	30—39 (N=66)	40—49 (N=51)	50+ (N=50)	Total (N=324)	Total (N=20,456)
	%	%	%	%	%	%	%	%
Below 20	3.1	15.5	14.3	15.2	13.7	16.0	12.7	15.1
20—24	NA	22.4	42.9	33.3	17.6	22.0	21.6	33.3
25—29	NA	NA	8.6	19.7	23.5	8.0	9.9	10.2
Over 30	NA	NA	NA	4.5	2.0	6.0	2.2	3.3
Age at first birth not known	—	—	2.9	10.6	33.3	44.0	14.5	—
No children	96.9	62.1	22.9	12.1	9.8	4.0	37.3	35.9
No relevant data	—	—	8.6	4.5	—	—	1.9	2.2
Total	100.0	100.0	100.2	99.9	99.9	100.0	100.1	100.0

Sources: fieldwork survey; Fiefia 1968: 58, 62.

114 given birth and none of those said to be twenty had already given birth, 125 whereas 15.5 % of the women aged 20—24 gave birth for the first time 163 before the age of twenty (see Table 2).

162 621 What is interesting is that the official report on the national census of 1966 presents similarly anomalous data in that 95.37 % of women 162 aged 15—19 had never given birth (Fiefia 1968: 58), whereas 15.1 % 163 of all women aged fifteen and over gave birth for the first time before 659 the age of twenty (see Table 2). The national census, however, does not give a breakdown of maternal age at the birth of the first child classified according to the woman's current age, so it is not clear whether these data are as problematic as the data from Motulahi. It should also be noted that the Census Officer for the 1966 census repeatedly mentions his reservations regarding the accuracy of the census data on age, and emphasizes this in commenting on the findings relating to maternal age at the birth of the first child (Fiefia 1968: 20), so the points is not that the problem is not recognized by those responsible for

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the national census. Rather, the point I wish to emphasize is that an ethnographer is generally in far the best position to provide data whose quality and accuracy are such that they may constitute a special contribution: first, by providing a check on the quality and accuracy of data collected by means of conventional censusing, and second, by facilitating demographic analyses that are either not possible or not feasible in the analysis of the conventionally-derived census.

As to the first contribution—providing a check on the quality and accuracy of data collected by means of conventional censusing—I shall give an example from Tongan data relating to migration.

Since Tonga is a country of many small islands, slight shifts of population may have important consequences and therefore migration is a matter of considerable interest. In the words of the Census Officer for the 1966 census,

> "It will be proposed throughout this Report that the Tongan population has become mobile, both internally and externally ... The movement of people between the islands especially to Tongatapu, has reached a stage where governmental intervention in the supervision and planning of these migrations is urgently required." (Fiefia 1968: 11.)

Clearly, the Tongan government would like to have information about migration. However, as the following discussion shows, the notion of migration is not culturally neutral and the problem is how data on 'migration' are to be obtained.

In the national census reports, both for 1956 and 1966, there is a comparison between place of birth and place of enumeration. The difficulty with this is that while such a comparison tells us something about population movement, it cannot be taken to be very informative about the rate and direction of migration. This is because in Tonga, particularly in the early years of a marriage until a couple establishes their own household, there is a great deal of movement back and forth between the wife's kin and the husband's kin. A child may be born at the home of one set of grandparents, live for some time at the home of another set (where some siblings may be born), and grow up at a third place where the parents have established their own household. The demographic difficulties resulting from this are partly recognized in the report on the 1966 census:

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> "As the Census was a de facto one, people were enumerated in wherever they were domiciled at the time of the Census. It is legitimate to assume that many people would be enumerated away from their village or island of birth. However, it would be false to assume that all persons enumerated away from their islands of birth were migrants, external or internal. Children are born in whatever village their parents happen to be residing at the time and they do not select their village of residence. A more realistic picture of any migration that has taken place can be obtained by examining the adult population which decides on the place of permanent residence. It is therefore justifiable to say that the majority of the adults who were born in one island but enumerated in another could be assumed to have migrated there." (Fiefia 1968: 21.)

As I understand it, there are two important points in the preceding passage. First, a child's moving from one place of residence to another is not a matter of the child's choice and therefore, while one can make inferences about an adult's residential preference from his place of enumeration, one cannot do this in the case of a child. Second, since a more realistic picture of residential preference is obtained by focusing on adults' residential mobility, the data on children's mobility should be excluded. Both points are well taken. However, an adult's being enumerated away from where he was born does not warrant the conclusion that his having moved there was a matter of his residential preference; he might have come there as a child. Thus, one does not get around the problem of correcting for children's residential mobility by limiting the comparison between places of birth and enumeration to adults. An indication of the extent to which such a comparison distorts the data is seen in Table 3, which distinguishes among adults living in Motulahi in 1970 according to the point at which they first came to live in the village. The table shows that while fewer than 30 % were born in Motulahi, more than half the adult population first lived in Motulahi before they were adults.

Clearly, a gross comparison of place of birth and place of enumeration is not very meaningful unless the residential circumstances at the time of birth and through childhood are known. Investigation along these lines, however, is hardly feasible in the collection and compilation of the national census. Furthermore, while such data could be obtained through

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162 166 621 *Table 3. Initial Residence in Motulahi of Adults Resident in Motulahi in 1970, by Age*

Circumstances of Initial Residence	Age Group			Total (N = 492) %
	20—29 (N = 174) %	30—49 (N = 224) %	50+ (N = 95) %	
Born in Motulahi	35.1	28.1	16.0	28.3
Came Before Age 20	31.0	25.0	11.7	24.6
Came as an Adult	33.9	46.9	72.3	47.2
Total	100.0	100.0	100.0	100.1

Source: Field notes.

125 ethnographic censusing, it is not clear how they are to be presented in a quantifiable form without violating their ethnographic integrity.

Thus, the problem of establishing culturally meaningful indices of migration in Tonga remains. One solution might be to examine how long each person has resided at the place of enumeration. Indeed, this was one of the recommendations made in the official report on the 1956 census (Tupouniua 1958: 28). The recommendation was not imple-
574 mented in the next census, however. The difficulty is that visiting away from home with friends and relatives for a few days or weeks is a favorite activity of Tongans, particularly among young unmarried adults, and such short-term population movements would distort any index of population flow based on the length of residence at the place of enumeration.
574 One cannot get around this problem by asking about the person's normal
591 or ordinary place of permanent residence, because Tongans do not have our concept of permanent residence; instead, they recognize different kinds of what we would call "temporary residence" (see Decktor Korn 1975). This difficulty might be dealt with by enquiring how long the person has/had been living at the place where he was resident for the majority of the previous twelve months. While this does not produce an index of migration, it could serve as an index of the extent of residential stability.

125 As to the question of population flow, an improvement on comparison of place of birth and place of enumeration would be to ask where the

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person had been living during (or for most of) his first year of attendance at primary school, and to compare this datum with the place of enumeration. The virtue of this datum is that is has a high degree of standardization (since attendance at primary school is compulsory for children over the age of six and does not begin before the child's fifth birthday), is easily recalled and can also be independently verified (by examination of school records), and eliminates the distortions introduced by short-term population movement. The problem of short-term movement to the place of enumeration remains, and this would have to be corrected for. Indeed, it is quite possible that a better index of population flow in Tonga could be devised. My point is that demographic indices, if they are to be of any practical use, must by ethnographically valid; and it is here that the ethnographer can make a special contribution to assuring the quality and integrity of demographic data.

The Ethnography of Ethnographic Censusing

Regarding the second contribution of ethnography to demography—that is, facilitating demographic analyses that are not possible or not feasible with the conventionally-derived census—the potential for this is dependent on the nature and quality of the ethnographer's census. Since I gave little thought to the demographic potential of the data collected in my household survey in Motulahi, something ought to be said about my purpose in collecting these data. Here I should admit that the primary reason for the survey was because this is the sort of thing that anthropologists conducting community studies do. Even the least statistically-minded ethnographer nowadays feels called upon to present a minimum set of quantifiable materials relating to persons and households in the locality, including data on such matters as property ownership, income sources, religious affiliation, and so on. Since I was based in a particularly large village, the simplest way of ensuring that I had a full set of data relating to every person and household in the village was to conduct a systematic house-to-house survey, and that is what I did. While conducting the survey I also took the opportunity to map the village, noting the boundaries of each residential plot and the placement of structures on the plot. Again, this is something that ethnographers do as a matter of course. In every household I tried to obtain a set of

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information about each person in the household: name, sex, relationship to head of household, age, marital status, place of birth, religious affiliation, whether or not the person had any land for cultivation registered in his/her name, the highest educational level attained, name and place of the last school attended, and a question about employment off the land and any additional sources of income.

While initially I set out to obtain these data in concise tabular form, I soon discovered that the survey responses served as a springboard for further enquiry and that, with very few exceptions, people did not seem to resent my many questions or object to how long it was taking. I therefore decided to take the opportunity of using the survey to enlarge and enrich my information about persons in each household. Thus the survey sheets became covered with cramped little notes and genealogical diagrams relating to such matters as the connection between natural and adoptive parents in cases of adoption (many of which I had not previously known to be cases of adoption), how a person came to have land where he did, whose land was borrowed, items relating to people's residential history, information I had not known about genealogical connections with people in other households in the village, and much more of a descriptive ethnographic nature. Later, in analysing some of these data, I found that they provided me with a demographic perspective on relations between the villagers and their chief, and this has proven invaluable in understanding the relationship between local history and social and economic developments in Tonga over the past few decades.

I am now somewhat abashed at the way I went about collecting these data. But I feel it is necessary to be candid about the push-broom mentality underlying my census-taking because I am sure that I am not alone in the haphazard way in which I collected a great deal of data, and that many if not most field ethnographers do the same sort of thing. Much of the material collected in this way is of potential demographic interest. For example, once I became aware of the possibility of extending my enquiries through the household survey, I took the opportunity to explore the question of the dispersal of nuclear-family members through adoption and fosterage, extra-local marriage, and other mechanisms. Although my inquiries were directed at the question of dispersal, I asked the parents to enumerate all their children so as to ensure that

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none was missed. In the course of this I was told about children who had died, and I noticed that in many families some child had died. I was particularly sensitive to this because I knew of two infants who had died in the period since I arrived in Motulahi (and a third died a few weeks before I left). Thus I began to ask explicitly about children who were no longer alive. By then, however, I was about half-way through the survey. So, while I have a fairly complete set of data relating to the number of surviving offspring, my information on the number of children ever born is incomplete and this limits the demographic value of my data on fertility and infant mortality. Similarly, I cannot make a complete enumeration of maternal age at the birth of the first child (even if I were sure of the woman's age), nor can I deal properly with the question of the length of birth intervals, because I failed to ask when children not resident in the household were born (see Table 2). These questions relate to demographic indices that are not available from the reports on the national census, and could have been an important contribution to the demography of Tonga (McArthur 1968: 94—95). Had I recognized the demographic significance of such enquiry at the time of fieldwork, the overall value of the data that I did collect could have been enhanced with little extra effort.

Conclusion

In this paper I have called attention to demographic aspects of some of the data anthropologists collect as a matter of course while in the field. Using materials from my own fieldwork, I have tried to show both the promise and the limitations of these data. My claim is that materials collected by anthropologists have considerable potential as a data-source for demographic analysis, but anthropologists must learn the elements of demography before they can be of more than limited use to demographers. My own case serves as an object lesson that unless anthropologists are mindful of the demographic implications of their data, they are likely to return from the field with material whose demographic value is limited because the data are incomplete.

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growth and movement, food production and the rise of tertiary industries.

Research Methods

Based upon the hypothesis of this study, three major divisions of research were discerned. First, the degree of population increase and the growth of urbanization was measured. This involved analysis of Tongan population data from the last thirty years (post-World War II).

Second, the changes in the agricultural profile of the nation were investigated. This involved a brief sequence occupancy survey in which the historical expansion of population onto agricultural land and the development of the traditional Tongan farm system ('api) was traced. In addition, a determination of the growth of cash cropping and the changing agricultural profile of rural Tonga was necessary. From these data, a pattern of population pressure upon agricultural resources was developed. Furthermore, any change in the purchasing power of rural Tongans was noted. This change proved to be (1) a decline in the support capacity of the land because of increasing population, resulting in land abandonment and poverty migration to the urban area, or (2) an increase in purchasing power and subsequent moves to the more attractive urban environment.

Third, once the pattern of urbanization was established, it was necessary to examine the food intake and basic nutritional status of the urban population, especially children. Two methods developed included a survey of available foods within the urban area,

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125 and a calculation of their basic nutritional content. (While protein was of prime importance, the effect of other macro nutrients, fat, and carbohydrates were also considered as were dietary minerals including zinc, iron and copper.) A second method involved a brief physical examination of a sample of Tongan children. This included such observations as teeth (caries), hair, general body tone and structure, plus a tricep skinfold measurement taken in conjunction with upper arm circumference.

121 With regard to population increases, a mathematical compari-
128 son of migration from Tonga, to immigration into the nation, provided
[127] an accurate estimate of population totals. Combining this estimate with data concerning growth in urban population and rural density, collected from census material, resulted in an indication of the distribution of population growth and migration potential.

121 Using agricultural data gathered from census materials and
127 ministerial reports, a brief historical outline (i.e., post-World
121 War II) of land usage patterns was developed. (The postwar period evidenced the most rapid population growth.) This indicated developmental trends in specific aspects of agriculture, such as cash cropping, the spread of plant diseases, etc., which altered agricultural patterns. Trends in land utilization and land abandonment were established, such as tenancy, absentee landholding, etc.

121 Assessing the nutritional status of urban population and
125 geographically comparing these findings with rural inhabitants became a major undertaking in itself. However, because alteration in nutritional status was to be related to urbanization only in

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121 cause and effect, extensive scientific investigation, such as blood
125 assay of amino acids, was not necessary.

125 There are three reasonable approaches which can be followed in collecting data for this comparison. First, food consumption surveys, using selected families, were employed. In this approach a record of food and approximate amounts used was made. This technique also supplied data pertaining to food availability, by type, for both rural and urban areas. The disadvantages of using household food consumption surveys were (1) the survey would have been necessarily limited due to the time involved, and (2) the difficulty an outsider encounters communicating in a traditional society concerning a personal topic. Secondly, the determination of nutritional status employed anthropometric measuring of subjects (head, upper arm, chest circumference plotted against established standards by age). Third, a clinical analysis utilizing hair root diameters as a precise measurement of nutritional status was undertaken. (Studies have shown strong correlation between hair root examination and serum amino acids and anthropometric measurements [Bradfield, 1972 and 1971; Nommacher 1972].) It was felt that this technique, when used in conjunction with the above anthropometric measures, would provide an almost foolproof comparison of rural and urban children with respect to nutritional status and physical growth and development.

In data collecting, every effort was made to avoid environmental, physical, or nutritional influences which would have resulted in skewed or distorted conclusions. All children of the

125 survey sample were examined within a 4-week period. Standards for physical measurements and hair sampling were observed in that each child was measured on the same anatomical site and hair samples were taken from the same scalp location[1] (note procedures in Appendix C). A Efforts were also made to insure the sample was a cross-section of Tongan population which involved no particular religious or economic group in excess.[2] Therefore, it was fully recognized from the onset of this research that in surveys of an entire population, as well as specific groups within the population, one should make every possible effort to gain results which are representative and unbiased. The sampling took into account specific cultural and occupational characteristics of the area and the population.

After the individual sample subject was selected, every effort was made to gain complete information for that subject. Of the total sample, a research sampling of 265 Tongan preschoolers were selected from rural and urban areas throughout Tonga. In the selection of each subject, care was taken that only one per family was included in the sample. Upon initial inspection, if the child was

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[121] [262] [1]The possibility of such dietary variations as mineral consumption between rural and urban children was recognized as a factor which could result in differences in the growth profile between the two groups. Research pertaining to such cause and effect was not undertaken within the scope of the present endeavor. However, one possibility for future research is seen in the role of zinc in relation to the large consumption of wheat bread in urban areas.

[795] [184] [145] [2]The most obvious case was that of Mormon (Latter Day Saints) families. Without exception, children in these households appeared better cared for in terms of physical development and general conditioning. This distinction was noted early in the sampling process and was compensated for.

A [See Category 125, p. 183-188—Analyst.]

125 determined to be abnormal in his physical development, i.e., unusually large or small for his particular age group, his survey form was not included in the research survey.

241 factor in Tongan society reduces the incentive for increased
241 production. Individuals who manage to significantly increase their
571 production of crops or agricultural profits are under social pres-
426 sure to supply loans and miscellaneous obligations to close rela-
tives and friends. This practice severely reduces the independence
of the farmer. Several informants stated that they would not
increase crop production because neighbors and relatives subse-
426 quently "borrow" all extra produce. Although lending is a tradition
556 which increases the social status of the lender, resentment toward
178 this social obligation is increasingly expressed among younger land-
holders, who place higher esteem on cash than tradition.

241 At present, the typical farmer appears to work his 'api an
461 average of 18 to 20 hours per week. The remaining time is occupied
[125] by a variety of additional activities. Although statistical evidence
of the duration of each activity was not collected, three activities
241 appeared to be dominant. Owing to the distribution of population
461 and the subsequent pattern of settlement, a farmer often spends
484 several hours per day traveling to and from his 'api. Travel
extremes from zero to 21 miles were reported by interviewees. Occa-
sionally, informants reported leasing land on nearby islands, which
necessitated travel overland, as well as by boat. However, an
average of 6.75 miles was determined to be the distance necessary
[494] for the typical farmer to travel to his 'api. Although the principal
islands of the Kingdom have bus transportation, the busses average
no more than 15 miles per hour, thereby consuming at least an hour
of travel per day for the average farmer. Frequently, walking for

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146 Malnutrition was further reported to be the fifth leading cause of death among young
165 in-patients at Vaiola hospital on Tongatapu in 1971 (Jansen 1973, p. 3).

146 It is probable that borderline malnutrition, or at least undernourishment, has existed in the South Pacific to some degree
[161] since the influenza epidemic of 1918. Rapid population growth has been prevalent and unabated since that time. The situation in such
369 urban environments as Nuku'alofa is becoming serious with regard to
511 nutrition and general well-being. The high cost of living and
146 underemployment, aggravated by the overflow of unskilled or semi-skilled laborers, has resulted in a subsequent increase in the number of malnourished children. Foods such as yam, fresh fish and fruits which traditionally were eaten by all Tongans are now, for many families in Nuku'alofa, a luxury beyond their economic means.
369 Money secured through cash cropping, relatives or overseas remit-
511 tances often is insufficient to support a large urban family and
146 migrating relatives. Jansen (1973) concluded that under prevailing conditions,

> two points must be kept in mind: a. in spite of socio-economic progress, technology, better education, etc., many children in the Pacific Islands actually die because they lack proper food; b. the survivors may be permanently stunted in physical, and possibly mental, development (Jansen 1973, p. 43).

121 In the present investigation, the incidence of protein mal-
125 nutrition or undernourishment was of prime interest. Throughout the sample survey, children of preschool age groupings (here defined as 2 years 0 months to 5 years 0 months) were examined. Data presented

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125 in previous chapters indicated the economic and environmental factors conducive to the development of nutritional disorders. Preschool children were chosen as subjects, in that they are the most dependent on household food supplies. The selection of the sample was conducted randomly, within such cross sections of Tongan society as religion, economic and social standing. Collected data from 265 preschool children (114 female and 151 male) was then examined in light of possible rural/urban variations in nutritional well-being. For a more complete description of data collection procedures, see Appendices B and C.

121 The prevalence of protein malnutrition represents a serious risk in Tonga, for several reasons. A correlation between urbanization and the incidence of protein malnutrition, as well as additional nutritional factors, adds a new dimension to any consideration of the urban process in Tonga or the South Pacific in general. With regard to the individual, lesser degrees of protein malnutrition may cause retarded physical growth (most obvious in height and weight). In addition, a malnourished individual suffers more from a variety of common infectious diseases than does a well nourished person.

262 [121] In any consideration of food production, distribution, consumption and value patterns, a variety of cultural factors must be recognized. In Tonga, several such factors have a profound influence upon the quantity and quality of food consumed by the preschool child. Aside from purely economic factors, which frequently dictate quantity and quality of food consumed, the family size and age spacing are also important. Cultural patterns, which determine the

[See Category 125, p. 174-188--Analyst.]

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262
146 and are often excluded from the diet.[1] On the other hand, imported
262 foods are perceived as being prestigious items. Some imports have
146 limited nutritional value, although often below that of domestic
263 products, while others such as refined flour, cereal products and sugar may cause or aggravate conditions of ill health, sugar being
263 an obvious offender. Hansell (1962, p. 288) listed increased sugar
164 consumption as being the principal cause of the rapid rise in the incidence of dental caries in Tonga. Personal observations verified this situation, with a marked predominance of cases noted in Nuku'alofa.

125 During the data collection process, a 24-hour dietary recall was conducted for each preschool subject, to determine any obvious dietary variations between rural and urban children. In addition, a frequency of consumption record was taken for the entire family, listing the frequency during an average week with which selected foodstuffs were consumed (i.e., fresh or canned meats and milk, tubers, cereal products, soft drinks, alcoholic products and sugar). In collecting this data care was taken to avoid the inclusion of
[52] weekend food consumption, especially that of Sunday. Because Sunday
[574] is a traditional day of feasting and heavy eating, a 24-hour dietary recall of this day would give a skewed and unrealistic picture of the preschooler's food consumption pattern.

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[1] The best example of this is the leaf of the taro plant. The leaf is used in the preparation of many dishes called "Lū" (i.e., lū pulu or beef, lū ika or fish) in which the meat is, in combination with coconut cream, etc., wrapped in taro leaves and cooked. However, the prepared dish is usually eaten without the leaf wrapping. In addition, raw vegetables, such as cabbage or greens, are not eaten.

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125 The information acquired for the household frequency of consumption record usually consisted of rough approximations. However, several important aspects became evident during the rural to 263 urban comparison. For example, household usage of sugar was found to be as high as 3.31 pounds per person per week in Nuku'alofa, although the average for the entire urban sample was 1.18. On the other hand, rural consumption of sugar averaged only .57 pounds per 262 week. Cereal products, including bread and flour, are also used in greater quantities in Nuku'alofa than in rural areas.[1]

[272] [273] The consumption of soft drinks, alcoholic products, and cassava significantly increased in the urban areas, while the consumption of yams decreased. [435] In the case of tubers, this fact most probably reflects economic forces which dictate that a basket of cassava cost T$.80, while a basket of yams sells of T$10-12.[2]

A higher rate of consumption of canned meat products was also observed in the urban area, although this product is widely used throughout Tonga--a probable reflection of its ease of distri- 125 bution, storage and social status. A purchase of two samples of 146 the most commonly used canned meat, and a subsequent proximal

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[443] [438] [1]This data may have been influenced by the distribution of such products over the islands. Surveys of stores in rural villages indicated that often sugar, flour and bread were not in stock. At times, the entire Kingdom is devoid of such basic commodities as sugar or flour. In one such incidence, over two weeks elapsed before a new shipment arrived from overseas sources, during which the entire nation lacked sugar. However, even with consideration being given to these influences, a significant variation between rural and urban consumption is evident.

[2]Prices acquired in the Nuku'alofa market, October, 1974.

125 analysis of these samples revealed that in each case, quality was
146 below suggested standards in content of protein, fat, carbohydrate
146 and moisture (Table 21). This was especially true of the sample of
435 K. & R. Corned Meat Loaf. This product is frequently consumed in
[262] Tonga, a probable reflection of its lower cost. Price surveys indicated that this meat loaf sold for approximately T$.30-.35, while the other canned meat sample analyzed sold for T$.75-.85.[1]

262 Fresh beef from Australia and mutton from New Zealand are
146 also consumed in greater quantities in urban Tonga. Analysis of
[125] random samples purchased in Nuku'alofa showed the surface fat of beef imports to be in excess of 73 percent of total product weight. Similarly, mutton samples not only evidenced a high fat content but were also greatly weighted by bone.[2]

262 On the other hand, individuals residing in rural areas consume more fresh meats such as pork, poultry, and fish (although fresh and canned fish are popular throughout the Kingdom), plus a greater variety of tubers. Yams, sweet potatoes, and taro retain their important traditional role in the Tongan diet within the rural

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[439] [656] [1]The results of the analysis of both products, which are imported from Australia, emphasize the fact that the Tongan government, despite recommendations by members of medical professions and church groups, refrains from monitoring the quality of products imported into Tonga. This neglect is exploited by foreign commercial organizations as evidenced by the analysis of the above canned meats, in addition to imported fresh meat samples (Appendix C).

[659] [2]The Tongan government recently announced plans for a refrigerated vehicle to transport fresh meat to rural Tongatapu. The value of such a scheme is questionable, considering the low quality of the products to be transported.

A A [See Category 125, p. 186-188--Analyst.]

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rural Tongatapu. These people, displaced by overpopulation, the lack of land or through the development of cash cropping, represent a critical potential risk for the development of classical malnutrition.[1] A situation cited as being conducive to the development of malnutrition involves a child with diarrhea (as is common in weaning infants) being fed only warm sugar water, a folk medicine remedy. This treatment tends to aggravate the initial condition and the cycle develops and intensifies (Tu'itavaka 1974). Subsequent manifestations of malnutrition are a lessening of the child's activity level, an increase of irritability and a retardation in the physical growth and development of the child.

During the investigation designed to determine the physical conditions of Tongan preschool children, height, weight, arm circumference and skinfold measures were recorded, as anthropometric indicators of a child's growth and development. Data from each indicator was grouped as to rural or urban and compared to suggested standards (The Health Aspects of Food and Nutrition 1972, pp. 278-283). Percents of variation from standards were then taken and

[1] The development of the symptoms of malnutrition (i.e., retarded growth and development in preschool subjects) was not strongly correlated to densely populated rural areas such as rural Ha'apai and western Tongatapu. Interview responses indicated no cases of malnutrition in these areas, which may be attributed to the greater availability of protein. The Nuku'alofa environs produced the greatest number of cases of malnutrition with Neiafu containing the second largest number. Only one case of malnutrition from the outer islands was reported. The staff of Vaiola hospital on Tongatapu believe malnutrition in Tonga is strongly linked to continued urbanization. (Interview with S. U. Tu'itavaka, Vaiola Hospital, Nuku'alofa, Tongatapu, September 24, 1974.)

141 Skinfold and circumference measures substantiated this
145 trend. In each case the urban child was found to be smaller and
146 less developed. Skinfold data, summarized in Table 24, evidenced the greatest variations between urban and rural children. Skinfold measurements of rural preschool children of both sexes were significantly higher than their urban counterparts, resulting in variation between the two sample groups of 24.38 percent for male subjects and 26.55 percent for female subjects. Circumference data (Table 25) also showed a variation in the development of rural and urban subjects. When compared to suggested norms, rural preschoolers had greater upper arm circumference measurements than urban children by 3.29 percent for male children and 2.80 percent for female children.

Considering the above four physical parameters measured on each preschool subject, it is conclusively evident that the rural child is physically larger and more developed than his urban
125 counterpart. A final nutritional evaluation technique was conducted in which a sample of each child's hair was collected using the pro-
128 cedure outlined in Appendix C.[A] Later, each hair specimen was examined and classified as to growing phase (i.e., growing or anagen, and resting or telogen), and bulb and shaft morphological changes. A hair in the growing or anagen phase is characterized by a bell-shaped bulb structure and solid dark pigmentation. The telogen bulb is shaped like a teardrop and shows a distinct lack of
146 pigment (Bradfield 1972, p. 721). Protein malnutrition, in particu-
128 lar, causes hair to shift to the telogen phase. Rural hair samples

[A] [See Category 125. p. 184-185--Analyst.]

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APPENDIX B

125

RESEARCH SURVEY

(Demographic)

1. Location _____ Urban____

_____ Rural____

2. Type of Household

Single family ____ Multiple family ____

Family and relatives____ Mult. family and rel. ____

Family and friends ____ Mult. family and friends___

3. Age-Sex Structure

0-2____ 10-14____ 25-29____ 50-59____

3-5____ 15-19____ 30-39____ 60-69____

6-9____ 20-24____ 40-49____ 70+ ____

4. Occupational and Educational (Household Head)

Educ: Primary_____ Univ._____

Secondary____ Tech. Sch.____ Type of Train._____

Occup.: Agri._____ Skilled_____ Share_____

Fish_____ Wt. Collar_____ Unemp._____

Unskilled___ Self Employ.___ Location of Emp.___

(Migration)

5. Time household lived in present location

0-1____ 5-9____ Life_____

2-5____ 10+____

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125 6. If less than life in same village

Other places lived and how long prior, or between moving to

T._____ _____

H._____ _____

V._____ _____

7. Does this household intend to remain permanently in this village?

Yes____ No____

Why?_____

8. Why moved to this village

Employment____ Health Care____ Relatives____

Land ____ Food Avail.____ Friends ____

Educ. ____ Religion ____

Other_____

9. Household members who have left or entered in past year

Sex____ Age____ Loss or gain____

Perm. or temp.____ Where_____

Reason for move_____

(Land)

10. Size and location Town____ Ac._____

Tax_____ Ac._____

Distance from dwelling _____ mi.

Landless____ Reason_____

11. Considering existing land tenure system satisfactory.

Yes____ No____

Reason_____

125

12. Do any other people use the same land for any type of Agri. production?

No____ Yes____

How long_____ Type of use_____

Reason for use_____

13. Number of people supported from land_____

14. What is the best size for a Tongan 'api_____ac.

(Agriculture Production)

15. Who operates farm: Head____ Family____ Others____

16. Main crops grown by household during 1973-74.

Main Crops Amt. Grown

_____ _____ ac. yield_____ Single Crop____

_____ _____ ac. yield_____ Double Crop____

_____ _____ ac. yield_____ Triple Crop____

Fallow land_____ac.

17. Fallow usage (ex. coconuts)_____

Time in fallow_____ Hist. increase____ Decrease____

18. Livestock, 1973-74

	Head	Slaughtered	Given Away		Sold	
Horse	_____	_____	____%	____	____%	____
Cattle	_____	_____	____	____	____	____
Goat	_____	_____	____	____	____	____
Pig	_____	_____	____	____	____	____
Fowl	_____	_____	____	____	____	____
Other	_____	_____	____	____	____	____

● 125

19. Length of time (day) spend working farm lot_____ hr.

Work for others: No____ Yes____ Payment_____

20. Use of farm equipment, and farm fertilizer

knife ____ spade____ tractor____

hoe ____ ax ____ own equip.: No____ Yes____

stick ____ plow ____ equip. not owned___

Use animal manure: No____ Yes____

Human manure: No____ Yes____

Commercial fert.: No____ Yes____

Frequency of usage of fert._____yr.

21. Use of fertilizer, seed, spray, dust, 1973-74

	Frequency	Amount	Where Obtained	Cost
Fert.				
Seed				
Spray				
Dust				
Tin prot. strips				
Pest Control				

22. Major limiting factor to increased prod. on farm in order of importance.

Lack of land_____

Disease of crops_____

Pest destruction_____

Use of produce by others_____

23. Is Agriculture important to this household as a means of livelihood?

Very ____ Not important____

Important____ Don't know_____

125

24. Occupational rating and reasons for preference

Agri._____ Prof._____ Self. employed_____

Fish_____ Skilled____ Wage-earning labor_____

Other_____

Reason_____

(Income)

25. What income was earned by household members in nonagricultural employment:

Member	Occupation	Where	Earning	wk.	mo.

26. Livestock and crop sold during year:

Commodity	Quantity	Value	Where sold

27. Fishing produce sold:

Commodity	Quantity	Value	Where sold

28. Other sources of income (handicrafts, etc.):

Source	Type of income	Amount	Where sold

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● 125

(Expenditure)

29. Food per week bought:

Item	Quant.	Cost (Unit)	Where bought	Meth.of Pay

Total food value per week_____

30. Farm needs during year:

Item	Quant.	Cost	Where bought	Meth.of Pay

31. Other spending during year (approx.):

Clothing_____ Church_____

School_____ Other_____ Value_____

_____ _____

_____ _____

(Household Possessions)

32. Does this household possess:

Radio _____ Food cabinet _____ Community H_2O _____

Telephone _____ Electricity _____ Indoor toilet _____

Refrig. _____ Indoor H_2O _____ Indoor washing _____

(Attitude to Population Size)

33. Is this household overcrowded: No_____ Yes_____

If No___, will you have any more children? No_____ Yes_____

●125

34. Is this village overcrowded? No_____ Yes_____

Is this island overcrowded? No_____ Yes_____

Is Tonga overcrowded? No_____ Yes_____

Will Tonga be overcrowded in the future? No_____ Yes_____

When?_____

What is the best number of population for Tonga?_____

Religion_____

35. How many children is best for a Tongan family?_____

36. Does any member of this household use or subscribe to any form of birth control?

Member	Type of BC	How long
_____	_____	_____
_____	_____	_____

37. Is family planning important for this household? No___ Yes___

Is family planning important for Tonga? No___ Yes___

38. Is the present family planning program adequate for Tonga?

No_____ Yes_____

39. Do you consider Tonga's growing population associated with problems of

Unemployment _____ Lack of available land _____

Lack of education _____ Difficulty of food prod._____

(Child Survey)

40. Sex_____ Age, Yr._____ Mo._____ Date of Birth_____

Height _____ cm. Weight_____ kg. Breastfed_____ Time____

41. Left arm circum. _____cm.

Left arm tricep Sf. _____mm.

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● 125

42. Hair sample taken? No____ Yes____

43. General appearance

Skin_____ Eyes_____ Hair_____

Teeth_____ Frank Nutr. disorder_____

44. How often does this household have: (week days) Meat:

Mutton_____ Tinned___ Fresh___ Bread_____

Beef_____ Tinned___ Fresh___ Biscuit_____

Pork_____ Tinned___ Fresh___ Rice_____

Fish_____ Tinned___ Fresh___ Butter_____

Poultry____ Tinned___ Fresh___ Coconut milk_____

Milk_____ Coconut flesh_____

Tinned sweetened_____ Yam_____ Soft drinks_____

Powdered_____ Potato_____ Canned jam_____

Fresh_____ Taro_____ Alcoholic_____

Cassava_____ Flour (pd.)_____

Sugar (pd.)_____

45. Dietary Recall (24 hr. for _____)

Breakfast Lunch Dinner Other

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APPENDIX C

DATA COLLECTION CRITERIA

125

Physical Examination

In conjunction with the population survey a brief physical examination of each preschool child residing in the sample households was conducted. The following indicators of nutritional and general well being were noted:

125 1. Skin changes. Careful observation was especially given
146 for flake-paint dermatosis, which may characterize severe protein malnutrition. However, only one such case was noted and that child was a weaning infant and too young for inclusion in the survey
125 sample. Skin areas with open wounds resembling burns or infection
146 were examined also. Though the incidence of infection was quite
164 common within the urban sample, it was impossible to directly attribute any to nutritional disorders alone, and probably reflect the effects of the total urban environment.

125 2. Edema. Each child's feet, ankles, hands and wrists
146 were examined for this characteristic of severe protein malnutrition. Several cases of this, in generalized form, were observed in the urban sample, although absent in rural areas. Several infants, not included in the sample, were also noted as having this condition.

3. Eyes. Vitamin A deficiency symptoms were noted to be common throughout Tonga. Parents frequently indicated that their

125 146 children showed symptoms of night blindness. Bitot spots, xerosis, xerophthalmia and keratomalacia were also noted.

4. Hair changes. Principally, dyspigmentation of hair color from the characteristic black to a reddish brown was noted. [302] However, the possible use of domestic or imported dye (frequently perceived as a status item) lessened the reliability of these observations. None the less, microscopic examination of hair samples verified that changes in pigmentation were greater within the urban sample.

5. Muscle wasting. This condition was noted in only one case in the total sample. Given the high caloric and starch diet of the Tongan, it is reasonable that such cases are rare.

125 6. Anthropometric indicators. Each child's height, weight, left arm circumference and tricep skinfold measurements were recorded. Height was taken using a vinyl tape, in conjunction with a back and head rest. The circumference measurement was acquired following the standard procedure of measuring halfway between the acromial process of the scapula and the point of the elbow. Weight was taken using a bathroom scale, adjusting the reading to zero prior to each weighing. Skinfold measures were taken three times and the average was recorded.

125 126 7. Hair. Hair specimens were also obtained from each preschool child examined. Care was taken to obtain specimens having the hair root intact. The procedure followed that outlined by Bradfield (1972), and varied only in the number extracted from each

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125 child.[1] Samples were stored in numbered postage envelopes for
126 transit from Tonga, the numbers corresponding with those of the appropriate survey forms.

128 Examination and analysis of collected specimens also fol-
125 lowed the procedure outlined by Bradfield. Samples were first separated by growth phase (i.e., anagen [growing], telogen [resting]) followed by a classification of morphological changes in each phase. Bulb diameter was determined, using a standard dissecting microscope equipped with a micrometer eyepiece. Two measurements for each sample were taken and the average determined. The percent of atrophy (an atrophied bulb is shrunken, having a shriveled appearance and a considerable decrease in bulb diameter) was also determined.

Alterations in bulb, sheath and hair shaft were also noted and classified, although growth phase, root bulb diameter and percent of atrophy were of prime importance to the research. Results of the above were then compared with the figures in Table 26, A which suggests standards for preschool children. The standards formulated by Bradfield were developed from studies of children with Asian and Negroid hair types.

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[1] Because root presence was determined at the time of collection, fewer hairs were necessary than that suggested by Bradfield (1971, p. 70).

A [See Category 128, p. 146—Analyst.]

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Tinned Mean Samples

● 125 Two samples of tinned meat were purchased in Tonga and subsequently analyzed upon completion of the data collection process. 125 The selection of the meat samples was based upon the criteria which 262 influence their consumption by the Tongan people: (1) availability 435 throughout the islands, determined during price surveys in village and urban shops; and (2) price, K. & R. brand Corned Meat Loaf being usually the cheapest of the tinned meat products of comparable variety. It appeared that the large-scale consumption of the meat loaf was based solely upon price as it was perceived to have the lowest prestige value of all tinned meats. Globe Corned Beef, the other tinned meat sample selected, enjoyed a much higher status ranking but had a medium price, making it more acceptable than products advertised to be better quality tinned beef products.

128 Each product was analyzed by proximal determination, which 125 supplied values for protein, fat, moisture and ash. Carbohydrate values were determined by the subtraction of the total values for protein, fat, ash and moisture from 100 percent. The Kjedahl-Total Nitrogen method as described by McKenzie was used to determine the protein content while fat content was discovered using the Soxhlet method (McKenzie and Murtphy 1970, p. 158). Moisture was determined by weighing a sample of the product, vacuum drying it at 100°F for 5 hours, and then reweighing it. Ash content determination called for charred samples being placed in a Muffle oven at 500°C for not less than 6 hours.

Two samples of each product were analyzed, as explained above, and the averages were calculated. The results were presented in Table 21.[1]

Fresh Meat Samples

Fresh meat samples imported from Australia and representative of available supplies found in Nuku'alofa were also purchased in four stores. Prices of the product varied from T.50 to .70 per pound. (At the time of purchase, October, 1974, U.S. $1.00 equaled T.63.) Small samples of the meat were weighed on a standard Welch balance. Surface fat was removed from each using an ordinary paring knife, followed by weighing. Next, samples were placed in boiling water for four minutes. Recognizing that much of the weight of the melted fat was replaced by water, attempts were made to thoroughly dry each sample over slow heat, prior to reweighing. Although this procedure is not the recommended methodology for fat determination of fresh meat samples, the results nonetheless provide a crude approximation of value. The results of this procedure are presented in Table 28.

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[1] A complete explanation of the procedures used in this analysis may be found by consulting the Official Methods of Analysis of the Association of Official Analytical Chemists 1970.

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946 125

TABLE 28.--Determination of Fat and Lean Content in Fresh Meat (Beef) Samples Available in Nuku'alofa.

	Purchased Weight (Gm)	Weight Following Surface Fat Removal (Gm)	Weight Following Boiling and Drying (Gm)	Tissue (%)	
				Fat	Lean
Sample #1	148.4	65.0	45.1	69.61	30.39
Sample #2	263.4	111.1	87.8	66.67	33.33
Sample #3	168.2	38.1	28.4	83.12	16.88
Sample #4	225.5	75.3	57.7	74.42	25.58
Average	201.4	72.4	54.8	73.46	26.37